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THE NEW

FEDERAL CALCULATOR,

OR

SCHOLAR'S ASSISTANT:

Containing the most concise and accurate rules for performing the
operations in common Arithmetic; together with numerous
examples under each of the rules, varied so as to make
them conformable to almost every kind of business,

FOR THE

USE OF SCHOOLS AND COUNTING HOUSES.

BY THOMAS T. SMILEY,

TEACHER.

Author of an Easy Introduction to the Study of Geography Also, of
Sacred Geography, for the use of Schools.

Philadelphia:

PUBLISHED AND FOR SALE BY J. GRIGG, No. 9, NORTH 4th St.
AND FOR SALE BY BOOKSELLERS AND COUNTRY
MERCHANTS GENERALLY IN THE SOUTHERN
AND WESTERN STATES.

1830.

Eastern District of Pennsylvania, to wit:

L. S.

BE IT REMEMBERED, That on the fifteenth day of January, in the forty-ninth year of the Independence of the United States of America, A. D. 1825, JOHN GRIGG, of the said district, hath deposited in this office, the title of a book, the right whereof he claims as proprietor, in the words following, to wit:

"The New Federal Calculator, or Scholar's Assistant: Containing the most concise and accurate rules for performing the operations in common Arithmetic; together with numerous examples under each of the rules, varied so as to make them conformable to almost every kind of business. For the use of Schools and Counting Houses. By THOMAS T. SMILEY, Teacher. Author of an Easy Introduction to the Study of Geography. Also, of Sacred Geography for the use of Schools."

In conformity to the act of the Congress of the United States, entitled, "An Act for the encouragement of learning, by securing the copies of maps, charts, and books, to the authors and proprietors of such copies, during the times therein mentioned." And also to the Act, entitled, "An Act supplementary to an Act, entitled, 'An Act for the encouragement of learning, by securing the copies of maps, charts, and books, to the authors and proprietors of such copies, during the times therein mentioned,' and extending the benefits thereof to the arts of designing, engraving, and etching historical and other prints."

D. CALDWELL, *Clerk of the*
Eastern District of Pennsylvania.

Stereotyped by J. Howe.

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RECOMMENDATIONS.

AMONG the numerous recommendations received to this work, are the following:

Mr. John Grigg,

SIR, *Philad. March 8th,* 1825.

I have examined, with as much care as my time would admit, "The New Federal Calculator," by Thomas T. Smiley. It appears to me, to be a treatise on Arithmetic of considerable merit. There are parts in Mr. Smiley's work which are very valuable: the rules given by him in Barter, Loss and Gain, and Exchange, are a great desideratum in a new system or treatise on Arithmetic, and render his book superior to any on the subject now in use; and when it is considered that the calculations in the work are made in Federal money, the only currency now known in the United States, and that appropriate questions follow the different rules, by which the learner can be exercised as to his understanding of each part as he progresses; I hesitate not to say, that in my opinion, it is eminently calculated to promote instruction in the science on which it treats. Mr. Smiley deserves the thanks of the Public, and the encouragement of Teachers, for his attempt to simplify and improve the method of teaching Arithmetic.

I am yours, respectfully,
WM. P. SMITH,
Preceptor of Mathematics and Natural Philosophy.—No. 152, South Tenth Street.

SIR,

I have carefully examined "The New Federal Calculator, or Scholar's Assistant," by Thomas T. Smiley, on which you politely requested my opinion; and freely acknowledge, that I think it better calculated for the use of United States' Schools and Counting-Houses than any book on the subject that I have seen. The author's arrangement of the four primary rules is, in my opinion, a judicious and laudable innovation, claiming the merit of improvement; as it brings together the rules nearest related in their nature and uses. His questions upon the rules throughout, appear to me to be admirably calculated to elicit the exertions of the learner. But, above all, the preference he has given to the currency of his own country, in its numerous examples, has stamped a value upon this little work, which, I believe, has not fallen to the lot of any other book of the kind, as yet offered to the American public.

I am, sir, yours, respectfully,
JOHN MACKAY.

Charleston, (S. C.) March 29th, 1825.

From the United States Gazette.

Among the numerous publications of the present day, devoted to the improvement of youth, we have noticed a new edition of Smiley's Arithmetic, just published by J. Grigg.

The general arrangement of this book is an improvement upon the Arithmetics in present use, being more systematic, and according to the affinities of different rules. The chief advantage of the present over the first edition, is a correction of several typographical errors, a circumstance which will render it peculiarly acceptable to teachers. In referring to the merits of this little work, it is proper to mention, that a greater portion of it's pages are devoted to Federal calculation, than is generally allowed in primary works in this branch of study. The heavy tax of time and patience which our youth are now compelled to pay to the errors of their ancestors, by performing the various operations of pounds, shillings and pence, should be remitted, and we are glad to notice that the Federal computation is becoming the prominent practice of school arithmetic.

In recommending Mr. Smiley's book to the notice of parents and teachers, we believe that we invite their attention to a work that will really prove an "assistant" to them, and a "*guide*" to their interesting charge.

The Editors of the New York Telegraph, speaking of Smiley's Arithmetic, observe that they have, within a few days, attentively examined the above Arithmetic, and say, "We do not hesitate to pronounce it an improvement upon every work of the kind previously before the public; and, as such, recommend its adoption in all our SCHOOLS and ACADEMIES."

PREFACE.

Considering the number of works on Arithmetic which have been already published, it may be thought presumptuous in the Author to have added to the number. But in the present improved state of the art of imparting instruction to youth, and consequent attention to the books made use of for that purpose, it will scarcely be argued that it is *impracticable* to furnish schools with books on any of the usual branches of school education, better calculated for the purpose than those previously in use. Under this impression, the Author has presented "The New Federal Calculator" to the Public. Whether it is better calculated to facilitate the progress of the learner, in the branch of study of which it treats, than those which have preceded it, remains to be submitted to the test of experience. In forming the rules, particular care has been taken to render them as clear and explicit as possible, and to arrange them in such a manner, that they may be readily committed to memory. The acquisition of a thorough knowledge of the Rules, preparatory to working the Examples which follow each of them, is particularly recommended, as the progress of the learner cannot fail to be very much facilitated thereby.

The Interrogations which follow the Rules, are intended as an exercise to direct the attention of the learner in a particular manner to the Rules, and to fix them more permanently in the memory. It will be observed, that the Examples are principally given in Federal money, or dollars and cents, as being more conformable to the currency of our country, and the general mode of keeping accounts throughout the United States.

Observations might be made as to arrangement, &c.; but as those interested in the subject can only judge of the merits of the work by an examination of it, they are respectfully referred to the work itself, and solicited to give it such a perusal as may enable them to decide with impartiality on its claims for admission into schools, in comparison with other works on the same subject.

THOS. T. SMILEY.

Philadelphia, January, 1828.

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EXPLANATION OF CHARACTERS.

Signs.	Significations.
=	Equal; as, 20*s.*=£1.
+	More; as, 6+2=8.
—	Less; as, 8—2=6.
×	Into, with, or multiplied by; as, 6×2=12.
÷	By (*i. e.* divided by); as, 6÷2=3; or, 2)6(3.
: :: :	Proportion; as, 2 : 4 :: 6 : 12.
$\sqrt{}$ or $\sqrt[2]{}$	Square Root; as, $\sqrt[2]{64}=8$.
$\sqrt[3]{}$	Cube Root; as, $\sqrt[3]{64}=4$.
$\sqrt[4]{}$	Fourth Root; as, $\sqrt[4]{64}=2$, &c.
———	A Vinculum; denoting the several quantities over which it is drawn to be considered jointly as a simple quantity.

ARITHMETIC.

Arithmetic is that part of the Mathematics which teaches the art of computation by numbers.

All operations in Arithmetic are performed by means of the following figures:

Cipher	One	Two	Three	Four	Five	Six	Seven	Eight	Nine
0,	1,	2,	3,	4,	5,	6,	7,	8,	9.

NUMERATION.

Numeration teaches the proper disposition of figures to express any proposed number, when that number is too great to be expressed by a single figure.

When a number is expressed by more than one figure, the value of each figure is determined by the situation which it holds in relation to the others, as represented in the following table:—

Numeration Table.

Hundreds of Millions	*Tens of Millions*	*Millions*	*Hundreds of Thousands*	*Tens of Thousands*	*Thousands*	*Hundreds*	*Tens*	*Units*	
								1	*One.*
							2	1	*Twenty-one.*
						3	2	1	*Three hundred and twenty-one.*
					4	3	2	1	4 *Thousand* 321.
				5	4	3	2	1	54 *Thousand* 321.
			6	5	4	3	2	1	654 *Thousand* 321.
		7	6	5	4	3	2	1	7 *Millions* 654 *Thous.* 321.
	8	7	6	5	4	3	2	1	87 *Millions* 654 *Thous.* 321.
9	8	7	6	5	4	3	2	1	987 *Millions* 654 *Thous.* 321.

By the foregoing table, it appears that any figure in the units' place, represents only its simple value, or so many ones; but, by being placed in the tens' place, represents ten times as much as though it stood in the units' place; by being placed in the hundreds' place, a hundred times as much as it would if placed in the units' place, and ten times as much as it would if placed in the tens' place; and so on.

Though it is seldom necessary to make use of more than nine places, as in the table, yet it may be extended to a greater number, by making places for thousands of millions, tens of thousands of millions, hundreds of thousands of millions, &c.

To know the value expressed by any given number of figures.

Rule.

1. Read the figures from right to left: units, tens, hundreds, thousands, &c. as in the Numeration table.

2. To the value of each figure when it stands single, add the name of its place, and read the figures from the left to the right. Example: 321, three hundred and twenty-one.

Questions.

What is Arithmetic?

By what means are operations in Arithmetic performed?

What does Numeration teach?

When numbers are expressed by more than one figure, how is the value of each figure determined?

Recite the Numeration table.

Is it usually necessary to make use of more than nine places to express numbers? When necessary, how is the number of places increased?

Repeat the Rule to know the value expressed by any number of figures.

To write down a proposed number.

Rule.

Begin at the right hand, and proceed towards the left, writing units in the units' place, tens in the tens' place, hundreds in the hundreds' place, and so on.

Write down in figures sixty-five.

Write down ninety-six.

Write down three hundred and fifty-one.

Write down three hundred and ninety-six.

Write down one thousand two hundred and fifty-six.

Write down five thousand nine hundred and sixty-seven.

Write down twelve thousand seven hundred and eighty-four.

Write down twenty-five thousand eight hundred and seventy-six.

Write down seventy-six thousand five hundred and ninety-seven.

Write down one hundred and fifty-two thousand two hundred and sixty-five.

Write down two hundred and ninety-one thousand seven hundred and fifty-one.

Write down four hundred and eighty-nine thousand two hundred and ninety-six.

Write down nine hundred and fifty-six thousand two hundred and seventy-five.

Write down one million eight hundred and fifty-six thousand seven hundred and eighty-six.

Write down twelve million four hundred and ninety-three thousand two hundred and twenty-one.

* * *

There are two primary rules by which all operations in Arithmetic are performed: namely, Addition and Subtraction.

ADDITION.

The use of Addition is to ascertain the amount of two or more numbers when put together.

Rule.

1. Set down any one of the numbers, and place under it all the rest, in such a manner, that units may stand under units, tens under tens, hundreds under hundreds, and so on; and draw a line under the last.

2. Begin at the right hand, or units' column, and add together all the figures contained in that column.

3. Consider all the figures contained in the amount of the column, and set down under it all above an even number of tens, and carry one for every ten to the next column, proceeding in the same manner until all the columns have been added up, setting down the whole amount of the last column.

Proof.—Perform the addition downwards; and if the amount is the same as when added upwards, the work right.

Questions.

How many primary rules are there in Arithmetic, what are they called?

For what is Addition used?

How do you set down numbers which you intend to add together?

Do you commence at the right or left-hand column of numbers which you wish to add together?

When you have found the amount of all the figures contained in a column, how do you proceed?

How do you prove Addition?

Addition Table.

To use the table, look in the outside left-hand column for one of the numbers to be added, and in the top column for the other number; then in the square opposite the one, and under the other, the sum will be found.

	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10	11
3	4	5	6	7	8	9	10	11	12
4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14
6	7	8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14	15	16
8	9	10	11	12	13	14	15	16	17
9	10	11	12	13	14	15	16	17	18

Note.—If the pupil is required to commit the foregoing table to memory, his progress will be thereby very much facilitated.

Examples.

(1)

	Units.
	1
	3
	2
	4
	1
	2
1	3

(2)

	Units.
	4
	2
	1
	3
	5
	6
2	1

(3)

	Units.
	8
	4
	2
	5
	7
	2
2	8

(4)

	Tens.	Units.
	1	2
	4	5
	7	8
	2	1
	5	6
	7	8
2	9	0

(5)

	Tens.	Units.
	8	5
	3	4
	9	7
	5	6
	4	7
	3	2
3	5	1

(6)

	Tens.	Units.
	5	4
	7	9
	6	8
	7	9
	7	6
	8	4
4	4	0

(7)

	Tens.	Units.
	1	2
	3	0
	4	3
	2	4
	6	5
1	7	4

(8)

Thousands.	Hundreds.	Tens.	Units.
4	8	2	9
1	2	3	4
6	1	0	1
3	0	1	4
5	6	1	8

(9)

Tens of Th.	Thousands.	Hundreds.	Tens.	Units.
9	1	7	6	9
1	4	6	7	8
8	0	0	3	2
7	1	8	9	7
7	6	9	8	9

(10)

H. of Thou.	Tens of T.	Thousands.	Hundreds.	Tens.	Units.
8	7	6	9	9	4
2	1	3	6	7	8
4	8	2	9	0	6
8	0	9	7	6	9
3	7	6	9	8	0

(11)
3 8 9 2 6 1
7 8 9 7 9 4
8 4 9 7 9 8
4 8 7 6 9 7
9 9 9 9 9 6
9 4 8 2 1 9

(12)
2 1 3 6 7 8 4
8 2 9 7 6 9 8
8 2 9 7 6 9 4
4 8 9 7 6 9 5
1 2 3 4 6 9 7
7 0 9 2 0 3 2

(13)
3 7 6 9 6 9 4
4 9 7 6 0 8 2
4 5 6 9 7 6 1
8 2 1 3 2 4 3
4 8 7 6 9 6 2
4 8 7 6 9 2 0

(14) 37856	(15) 378269	(16) 141
975	402607	5672
1234	702	82971
14	1246	34676
5612	2132	1459
2075	45178	427
16287	10276	12

17. Add 14, 16, 23, 29, 80, 31, and 100 together, and tell the amount. *Ans.* 293.

18. What is the amount of 36, 97, 125, 384, 1176? *Ans.* 1818.

19. What is the amount of 3797, 95, 2, 75, 876, and 9750? *Ans.* 14595.

20. What is the amount of 205, 20, 840, 970, 367, and 1001? *Ans.* 3403.

21. What is the amount of three hundred and sixty-five, eight hundred and seven, five hundred and sixty, twenty-five, thirty-seven, and one hundred and one? *Ans.* 1895.

22. What is the amount of three hundred, seventy-five, two, forty-seven, thirty-three, nine thousand seven hundred and eighty-four, twenty thousand one hundred and fifty, seven hundred and sixty-five thousand and ninety-one, and one million seventy-five thousand and forty-seven? *Ans.* 1870529.

23. Add seventy-five millions nine hundred and sixty thousand eight hundred, two hundred and twenty-five thousand, and one hundred and forty, together. *Ans.* 76185940.

Practical Exercises.

24. In one pocket, I have thirty-five marbles, and in another 21; how many have I in all? *Ans.* 56.

25. John and Charles went to collect nuts; and when they had collected a quantity, they sat down to count them; when John found he had collected 275, and Charles 196: how many nuts did both of them gather? *Ans.* 471.

26. Having a mind to buy a suit of new clothes, I went to the tailor's, to see how much money would be necessary for that purpose; when I found he would charge for a coat 30 dollars, for a pair of pantaloons 12 dollars, and

for a waistcoat 5 dollars: what will the suit cost at that rate? *Ans.* 47*dols.*

27. A merchant sent out his clerk to collect money: he collected 50 dollars from one person, from a second 25, from a third 125, and from a fourth 216: how many dollars did he collect in all? *Ans.* 416.

28. A man set out on a journey, and travelled the first day 37 miles, the second day 33 miles, the third day 40 miles, the fourth day 35 miles: how many miles was he, at the end of the fourth day, from the place from which he started? *Ans.* 145.

29. A. has a flock of sheep containing thirty-four, B. has a flock containing forty-seven, and C. has a flock containing fifty-four: how many sheep are in all three of the flocks? *Ans.* 135.

30. A butcher bought of one man 25 head of cattle, of another 15, of another 40, and of another 9: how many did he buy in all? *Ans.* 89.

31. A farmer has four fields; the first contains 8 acres, the second 15 acres, the third 19 acres, and the fourth 12 acres: how many acres are there in all the four? *Ans.* 54.

32. A flour-merchant bought from one man 400 barrels of flour, for which he gave 2000 dollars; from another man 550 barrels, for which he gave 2750 dollars: how many barrels of flour did he buy, and how many dollars did he give for the whole? *Ans.* 950 barrels. 4750 dollars.

MULTIPLICATION.

MULTIPLICATION is a short method of performing Addition, when the same quantity is required to be added a given number of times.

There are three parts in Multiplication: viz.

The sum to be multiplied is called the *Multiplicand.*

The sum by which you multiply is called the *Multiplier.*

The result of the operation is called the *Product.*

The Multiplicand and Multiplier are likewise called both together *Factors*, or that by which the operation is performed.

Case 1.

When the multiplier does not exceed 12.

Rule.

1. Set down the multiplicand, or number to be multiplied, and, under the units' place of the multiplicand, the multiplier, or number by which you multiply.

2. Multiply each figure of the multiplicand in succession by the multiplier; set down the amount, and carry in the same manner as in addition.

Proof.—Multiply the multiplier by the multiplicand.

Note.—Multiplication and addition may likewise be proved by casting out the nines: but as the work will sometimes prove by that method, when in reality wrong, the rule is omitted.

Before proceeding farther, it is indispensable that the learner should commit the following table to memory.

Multiplication Table.

Twice		3 times		4 times		5 times		6 times		7 times	
1 make	2	1 make	3	1 make	4	1 make	5	1 make	6	1 make	7
2	4	2	6	2	8	2	10	2	12	2	14
3	6	3	9	3	12	3	15	3	18	3	21
4	8	4	12	4	16	4	20	4	24	4	28
5	10	5	15	5	20	5	25	5	30	5	35
6	12	6	18	6	24	6	30	6	36	6	42
7	14	7	21	7	28	7	35	7	42	7	49
8	16	8	24	8	32	8	40	8	48	8	56
9	18	9	27	9	36	9	45	9	54	9	63
10	20	10	30	10	40	10	50	10	60	10	70
11	22	11	33	11	44	11	55	11	66	11	77
12	24	12	36	12	48	12	60	12	72	12	84

8 times		9 times		10 times		11 times		12 times	
1 make	8	1 make	9	1 make	10	1 make	11	1 make	12
2	16	2	18	2	20	2	22	2	24
3	24	3	27	3	30	3	33	3	36
4	32	4	36	4	40	4	44	4	48
5	40	5	45	5	50	5	55	5	60
6	48	6	54	6	60	6	66	6	72
7	56	7	63	7	70	7	77	7	84
8	64	8	72	8	80	8	88	8	96
9	72	9	81	9	90	9	99	9	108
10	80	10	90	10	100	10	110	10	120
11	88	11	99	11	110	11	121	11	132
12	96	12	108	12	120	12	132	12	144

Note.—The multiplication table has not been usually extended further than twelve; but may be extended to any number, at pleasure; and if committed to memory to 50 or 100, will well repay the trouble of learning it.

Questions.

What is Multiplication?

How many parts are there in Multiplication? Name them.

By what name are the multiplicand and multiplier together called?

Repeat the rule for performing Multiplication, when the multiplier does not exceed 12.

How do you prove multiplication?

Repeat the multiplication table.

Examples.

Multiplicand.

(1) 13212	(2) 321434	(3) 32012341	(4) 421032413
2	2	2	2
26424	642868	64024682	842064826

(5) 4678219046	(6) 8270198049	(7) 7482976857
2	2	2
9356438092	16540396098	14965953714

(8) 3948769768	(9) 87051298	(10) 976201698769
3	4	5

(11) 456978426976	(12) 8079698769	(13) 97698429769
6	7	8

(14)	(15)	(16)
28769842369	769829769478	5697698976845
9	10	11

(17)	(18)	(19)
7029876958	84976876989	9021681409671
12	12	12

20.	Multiply	4218	by	2	*Ans.*	8436
21.	—	7321	by	3	—	21963
22.	—	87692	by	4	—	350768
23.	—	95698	by	5	—	478490
24.	—	10691	by	6	—	64146
25.	—	31078	by	7	—	217546
26.	—	109019	by	8	—	872152
27.	—	900078	by	9	—	8100702
28.	—	826870	by	10	—	8268700
29.	—	278976	by	11	—	3068736
30	—	12569769	by	12	—	150837228

Case 2.

When the multiplier exceeds 12, and consists of two or more figures.

Rule.

1. Set down the multiplicand, and under it the multiplier, in such a manner, that units may stand under units, tens under tens, hundreds under hundreds, and so on.

2. Then proceed to multiply all the figures of the multiplicand by the units figure of the multiplier, setting down the product as before.

3. After having multiplied by the units figure of the multiplier, then take the tens, hundreds, &c. proceeding in the same way with every figure, observing when you multiply by the tens figure of the multiplier, to set down the first figure of the product under the tens figure of the multiplier, and when by the hundreds, the first figure must be set under the hundreds of the multiplier, &c.

4. Add together the several products exactly in the places in which they stand, and you will have the last or final product.

Questions.

When the multiplier exceeds 12, and consists of two or more figures, when you have set down the multiplicand, how do you set down the multiplier?

How do you then proceed?

After you have multiplied by all the figures of the multiplier, and set down the products in their proper places, what is to be done to obtain the last or final product?

Examples.

(31)		(32)		(33)	
	375 multiplicand.		487		978
	5 multiplier.		25		375
	1875		2435		4890
	375		974		6846
					2934
	5625 product.		12175		366750

(34)		35)		(36)	
	39786948		4978829		8735698
	197		408		5706

(37)		(38)		(39)	
	84016978		49569876		9637842
	3761		4817		9078

40.	Multiply	9786	by	13	*Ans.*	127218
41.	—	8475	by	29	—	245775
42.	—	11271	by	35	—	394485
43.	—	19004	by	305	—	5796220
44.	—	76976	by	489	—	37641264
45.	—	84769	by	976	—	82734544
46.	—	1978987	by	4809	—	9516948483
47.	—	9807094	by	5047	—	49496403418

Case 3.

When there are ciphers at the right of either the multiplicand or multiplier

Rule.

1 Multiply as in the preceding case, only omitting the ciphers.

2. Then add together the several products, and place to the right of the amount as many ciphers as there are to the right of both the factors.

Question.

Repeat the rule for performing operations in multiplication when there are ciphers to the right of one or both factors.

Examples.

48. Multiply 3700 by 200 *Ans.* 740000
49. — 4870 by 2500 — 12175000
50. — 408700 by 906000 — 370282200000
51. — 876956 by 990000 — 868186440000

Case 4.

When the multiplier is exactly equal to the product of any two figures in the multiplication table, the operation may be performed by the following

Rule.

Multiply first by one of those figures, and that product by the other; the last product will be the answer.

Question.

Repeat the rule for performing the operation in multiplication, when the multiplier is the exact product of two numbers in the multiplication table.

Examples.

(52) Multiply 476 by 25. 5 times 5 are 25.

$$\begin{array}{r} 476 \\ 5 \\ \hline 2380 \\ 5 \\ \hline \textit{Ans.}\ 11900 \end{array}$$

53. Multiply 8976 by 48 *Ans.* 430848
54. — 7696 by 81 — 623376

55. Multiply 87698 by 72 *Ans.* 6314256
56. — 20784 by 108 — 2244672
57. — 81207 by 132 — 10719324
58. — 47696 by 144 — 6868224
59. — 75687 by 56 — 4238472
60. — 34075 by 36 — 1226700

Practical Exercises.

61. A man has 5 bags of money, and each bag contains 25 dollars: how many dollars has he in all? *Ans.* 125.

62. Charles has 15 marbles, and John 4 times as many: how many has John? *Ans.* 60.

63. A gentleman owns 7 houses, from each of which he receives yearly 250 dollars for rent: how much a year does he receive from the seven? *Ans.* 1750.

64. A labourer hired himself to a farmer for 4 years, at 150 dollars a year: how many dollars did the labourer receive for his four years' labour? *Ans.* 600.

65. A gentleman is desirous to purchase 25 shares of bank stock, at 100 dollars per share: how much money must he pay for the 25 shares? *Ans.* 2500.

66. A mason having built a house, found that he had used 18175 bricks in building it: supposing he is desirous to build 14 houses of the same size, how many bricks will be necessary? *Ans.* 254,450.

SUBTRACTION.

Subtraction is used to ascertain the difference between two given numbers.

The larger number is called the minuend, the less the subtrahend, and their difference the remainder.

Rule.

1. Set down the larger number first, and under it, (with units under units, tens under tens, &c.) the less number.

2. Then begin at the right hand or units' place, and take the lower figure from that which stands immediately

above, if the upper figure be more than the lower, and set down the remainder.

3. But if the upper figure be less than the lower, add ten to the upper figure, take the lower figure from the amount, set down the remainder, and carry one to the next lower figure.

Proof.—Add the less number and the remainder together, and the amount will be equal to the greater number.

Questions.

For what purpose is Subtraction used?

What names are used to distinguish the larger number, smaller number, and the difference between the two numbers?

Repeat the rule for performing operations in subtraction?

How is subtraction proved?

Subtraction Table.

To make use of this table, find the less number in the left hand perpendicular column, and opposite to it, in the horizontal column, the number from which you wish to take it; the figure immediately above, in the top line, will show their difference: as, 3 from 7, and 4 remains.

	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10	11
3	4	5	6	7	8	9	10	11	12
4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14
6	7	8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14	15	16
8	9	10	11	12	13	14	15	16	17
9	10	11	12	13	14	15	16	17	18

421352
210141
211211

Examples.

(1) 421352 minuend.
210141 subtrahend.
211211 remainder.

(2) 8576978
3246153
5330825

(3) 37569482
24978769
12590713

(4) 859768
124978

(5) 9076048
7940689

(6) 532147878
139876956

(7) 100000
84321

(8) 75381478
39040217

(9) 102070845
19768799

10.	From	196	take	37.	Remain.	159
11.	—	487	—	96.	—	391
12.	—	875	—	302.	—	573
13.	—	967	—	351.	—	616
14.	—	1001	—	487.	—	514
15.	—	9765	—	1307.	—	8458
16.	—	87696	—	10091.	—	77605
17.	—	455692	—	300120.	—	155572
18.	—	1000000	—	1.	—	999999

Practical Exercises.

19. Henry has 25 marbles, and Charles 8: how many more has Henry than Charles? *Ans.* 17.

20. William bought 75 nuts, and Edward 42: how many has William more than Edward? *Ans.* 33.

21 There are two piles of bricks; in the greater pile there are 7896, and in the less 4389: how many more are there in the greater pile than in the less? *Ans.* 3507.

22. A merchant bought 4875 bushels of wheat, out of which he sold 2976 bushels: how many bushels has he left? *Ans.* 1899.

23. I deposited in bank 1240 dollars; I drew out at one time 375 dollars, at another 567, at another 140: how many dollars still remain in bank? *Ans.* 158.

24. A farmer had 5487 acres of land: he sold to A. 325 to B. 750, and to C. 1000 acres: how many had he left? *Ans.* 3412.

25. A grocer bought 25 hogsheads of sugar, containing 250 hundred weight; and sold 9 hogsheads, containing 75 hundred weight: how many hogsheads, and how many hundred weight, had he left?

Ans. 16 hogsheads, 175 hundred weight.

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DIVISION.

Division is a short method of performing a number of subtractions, when the numbers to be subtracted all express the same quantity.

There are four terms made use of to designate the different parts of the operation of dividing: viz.

The number to be divided is called the *Dividend.*

The number by which it is divided is called the *Divisor.*

The number of times the divisor is contained in the dividend is called the *Quotient.*

If there is any left after the operation is completed, it is called the *Remainder*, and is always of the same denomination with the dividend.

When the divisor does not exceed 12, the operation is performed by short division.

SHORT DIVISION.

Rule.

1. Place the divisor to the left of the number you wish to divide.

2. Consider how many times the number by which you divide is contained in the first figure or figures of the number to be divided, and set down the result, noting whether there be any remainder.

3. If there be no remainder, consider how often the divi-

sor is contained in the next figure; but if there be a remainder, conceive it to be placed to the left of the next figure, into which divide as before, and set down the result.

Proof.—Multiply the quotient by the divisor, and add in the remainder, if any; the product will equal the dividend.

Questions.

What is division?

Name the four terms made use of to designate the different parts of an operation in division.

By what name is the number to be divided called?

By what name is the number by which another is divided called?

What is called the quotient?

What is called the remainder

How is division performed, when the divisor does not exceed 12?

Where do you place the divisor?

How do you proceed, after having placed the divisor to the left of the dividend?

If there be a remainder, or if there be no remainder, how do you then proceed?

How is division proved?

Division Table.

To use the table—

Look for the divisor, or number by which you wish to divide, in the left-hand perpendicular column.

Then trace the horizontal column, in which the divisor stands, until you find the dividend, or number into which you wish to divide; then trace that column to the top, and you will find the product, or number of times the divisor is contained in the dividend.

If you cannot find the exact number into which you wish to divide in the table, look for the next less one, and the difference between them will be what is over.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3		9	12	15	18	21	24	27	30	33	36
4			16	20	24	28	32	36	40	44	48
5				25	30	35	40	45	50	55	60
6					36	42	48	54	60	66	72
7						49	56	63	70	77	84
8							64	72	80	88	96
9								81	90	99	108
10									100	110	120
11										121	132
12											144

Examples.

(1) 2)482 — 241

(2) 2)648 — 324

(3) 3)963 — 321

(4) 4)484 — 121

(5) 2)326 — 163

(6) 2)3847 — 1923+1

(7) 2)56789768

(8) 3)3729768769

(9) 4)4697698766

(10) 5)849768769

(11) 6)756976874

(12) 7)87694213628

(13) 8)80269687

(14) 9)376948769

(15) 11)87695678

(16) 12)4976876946782

(17) 12)89769762048769

18.	Divide	3976	by	2	*Ans.*	1988
19.	——	8769	by	3	—	2923
20.	——	47876	by	4	—	11969
21.	——	8767	by	5	—	1753+2
22.	——	9698	by	6	—	1616+2
23.	——	97899	by	7	—	13985+4
24.	——	80409	by	8	—	10051+1
25.	——	981021	by	9	—	109002+3
26.	——	897697	by	10	—	89769+7
27.	——	9876978	by	11	—	897907+1
28.	——	4967844	by	12	—	413987

Practical Exercises.

29. Two boys have 12 apples, which they divide equally between them: how many have they each? *Ans.* 6.

30. If 350 dollars be divided equally among 7 men, how much will be the share of each man? *Ans.* 50.

31. What is the quotient of 8736, divided by 8 and by 4? *Ans.* 273.

32. There was a number of persons concerned in the payment of 3966 dollars, and every person paid 3 dollars: how many persons were there? *Ans.* 1322

LONG DIVISION.

Long division is used when the divisor exceeds 12.

Rule.

1. Place the divisor to the left of the dividend, as in short division.
2. Consider how often the divisor is contained in the least number of figures into which it can be divided, and set down the result to the right of the dividend.
3. Multiply the figure set at the right of the dividend by the divisor, and set the product under the figures in which you considered how often the divisor was contained.

4. Subtract the product from the line above it, and set down what remains, which must always be less than the divisor.

5. Bring down the next figure to the right of the remainder, and proceed as before, till all the figures of the dividend are brought down.

When there are ciphers at the right of both factors, the operation may be shortened, by cutting off an equal number of ciphers from each.

Questions.

When is long division used?

In what manner do you place the dividend and divisor, when working long division?

When you have considered how often the divisor is contained in the least number of figures into which it can be divided, where do you place the result?

When you have multiplied the figure placed at the right of the dividend by the divisor, where do you set the product?

How do you then proceed?

Examples.

```
     Divis. Divid. Quotent.                 Divis. Divid. Quotent.
(33)   13)8769(674                  (34)   27)984376(36458
          78                                  81
          --                                  ---
          96                                  174
          91                                  162
          --                                  ---
           59                                  123
           52                                  108
           --                                  ---
            7 remainder.                        157
                                                135
                                                ---
                                                 226
                                                 216
                                                 ---
                                                  10 remainder.
```

	Divide	by	*Ans.*	Rem.
35.	875	13	67	4
36.	476	15	31	11
37.	958	18	53	4
38.	1475	28	52	19
39.	4277	31	137	30
40.	25757	37	696	5
41.	256976	41	6267	29
42.	337979	48	7041	11
43.	997816	59	16912	8
44.	999987695	98	10203956	7
45.	4697680424	125	37581443	49
46.	387690204886	396	979015668	358
47.	4876020048769	876	5566232932	337
48.	8769826000402	1478	5933576454	1390
49.	98769768720497	87696	1126274501	80801
50.	89764789760000	976800000	91896	77696
51.	478976821400000	147698000000	3242	1399054

Practical Exercises.

52. What is the quotient of 9847 divided by 45?
Ans. 218, rem. 37.

53. What is the quotient of 1259678 divided by 391?
Ans. 3221, rem. 267.

54. The prize-money to be divided among a crew of 148 men, is 225476 dollars: what is the share of each man? *Ans.* 1523, rem. 72.

55. If a field, containing 25 acres, produces 375 bushels of wheat, how much is that for one acre? *Ans.* 15.

56. What number must be multiplied by 75, to produce 87735840? *Ans.* 1169811.

57. If 99700 pounds of bread be divided among 49850 soldiers, what will be the share of each man? *Ans.* 2.

When the divisor is the exact product of any two figures multiplied together, the operation may be performed by the following

Rule.

1. Divide by one of the figures, and then divide that product by the other.

2. If remainders occur, multiply the last remainder by the first divisor, and add in the first remainder.

9. If no remainder occurs, when dividing by the last divisor, the first remainder, if any, is the true remainder.

Questions.

When the divisor is more than 12, but is the exact product of any two figures multiplied together, how will you proceed?

If remainders occur, when dividing by both divisors, how will you obtain the true remainder?

If no remainder occurs when dividing by the last divisor, and one occurred when dividing by the first divisor, is that the true remainder?

Examples.

58. What is the product of 976 divided by 56?

7 times 8 are 56. 7)976
8)139+3 1st remainder.
Ans. 17+3 2d remainder.
7
21
3 1st remainder.
24 true remainder.

59. What is the product of 2796 divided by 81?

9 times 9 are 81. 9)2796
9)310+6 1st remainder.
Ans. 34+4 2d remainder.
9
36
6 1st remainder.
42 true remainder.

60. What is the product of 875 divided by 25?

5 times 5 are 25. 5)875

5)175

35 *Ans*,

61.	Divide	9756	by	35	*Ans*.	278	rem.	26
62.	——	8491	by	81		104		67
63.	——	44767	by	18	—	2487		1
64.	——	92017	by	56	—	1643		9
65.	——	55210	by	99	—	557		67
66.	——	38751	by	48	—	807		15
67.	——	99876	by	108	—	924		84
68.	——	37967	by	144	—	263		95

Practical Exercises.

69. Twenty-five sailors receive 3775 dollars for prize-money: how much is that for each man? *Ans.* 151.

70. Ninety-six soldiers are to have 480 pounds of beef divided equally amongst them: what is the share of each soldier? *Ans.* 5 pounds.

71. One hundred and forty-four men have to pay equal shares of a debt which amounts to 14400 dollars: how much must each man advance to make up the sum? *Ans.* 100.

72. Supposing 1800 apple-trees to be planted in 72 rows, how many trees are there in each row? *Ans.* 25.

73. The annual rent of a farm which contains 132 acres is 396 dollars: how much is that per acre? *Ans.* 3 dols.

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EXAMPLES,

Introduced to exercise the Learner in the promiscuous use of ADDITION, MULTIPLICATION, SUBTRACTION, *and* DIVISION.

1. A farmer who has 50 sheep, buys from his neighbour 50 more; he then sells 25 to the butcher: how many has he left? *Ans.* 75.

2. John had forty apples; he gave his brother 10, kept 10 for himself, and divided the remainder equally between his two sisters: how many had they a-piece? *Ans.* 10.

3. A gentleman dying, left his estate, which amounted to 25000 dollars, to his son and two daughters, as follows: to his son he gave 13000 dollars, and to his two daughters the remainder, to be divided equally between them: how much a-piece had the daughters? *Ans.* 6000 dollars.

4. A merchant bought 8200 barrels of flour; he then sold 3756 barrels; he then bought 5000 barrels; after which he sold 4879 barrels: how many barrels of flour has he still on hand? *Ans.* 4565.

5. A man who sets out on a journey, intends to travel 2450 miles: how far must he go every day, to perform the journey in 50 days? *Ans.* 49 miles.

6. A grocer bought 24 bags of coffee, containing 3000 pounds, and sells 15 bags, containing 1736 pounds: how many bags, and how many pounds, has he remaining?
Ans. 9 bags, 1264 pounds.

7. Supposing a man to receive in a year 2920 dollars, how much a day is his income at that rate; and supposing that his expenses for the whole year amount to 1769 dollars, how much will he save in a year?
Ans. His income will be 8 dollars a day, and he will save 1151 dollars a year.

TABLES

OF MONEY, WEIGHTS, AND MEASURES.

FEDERAL MONEY.

The denominations are,

10 mills (marked *m.*)	make	1 cent, *ct.*
10 cents	—	1 dime, *d.*
10 dimes (or 100*cts*)	—	1 dollar, *D.* or $
10 dollars	—	1 eagle, *E.*

ENGLISH MONEY

The denominations are,

4 farthings (marked *qr.*)	make	1 penny,	*d.*
12 pence	—	1 shilling,	*s.*
20 shillings	—	1 pound,	£.

The Farthings are written thus,

¼ one farthing.
½ two farthings, or a halfpenny.
¾ three farthings.

PENCE AND SHILLING TABLE.

	s.	d.		£	s.
20 pence make	1	8	20 shillings make	1	0
30	2	6	30	1	10
40	3	4	40	2	0
50	4	2	50	2	10
60	5	0	60	3	0
70	5	10	70	3	10
80	6	8	80	4	0
90	7	6	90	4	10
100	8	4	100	5	0
110	9	2	110	5	10
120	10	0	120	6	0
240	20	0	130	6	10

A TABLE OF COINS,

Which pass current in the United States, with their Sterling and Federal value.

Names of Coins.	Standard Weight.		Sterling Money of Great Britain.			N. Hampshire, Massachusetts, Rhode Island, Connecticut, and Virginia.			New York and North Carolina.			New Jersey, Pennsylvania, Delaware, and Maryland.			South Carolina, and Georgia.			Federal Value.		
GOLD.	dwt.	gr.	L.	s.	d.	L.	s.	d.	L.	s.	d.	L.	s.	d.	L.	s.	d.	D.	c.	m
A Johannes, - -	18	0	3	12	0	4	16	0	6	8	0	6	0	0	4	0	0	16	00	0
A half Johannes, -	9	0	1	16	0	2	8	0	3	4	0	3	0	0	2	0	0	8	00	0
A Doubloon, - -	16	21	3	6	0	4	8	0	5	16	0	5	12	6	3	10	0	14	93	3
A Moidore, - - -	6	18	1	7	0	1	16	0	2	8	0	2	5	0	1	8	0	6	00	0
An English Guinea,	5	6	1	1	0	1	8	0	1	17	0	1	15	0	1	1	9	4	66	7
A French Guinea, -	5	5	1	1	0	1	7	6	1	16	0	1	14	6	1	1	5	4	60	0
A Spanish Pistole, -	4	6	0	16	0	1	2	0	1	9	0	1	8	0	0	18	0	3	77	3
A French Pistole, -	4	4	0	16	0	1	2	0	1	8	0	1	7	6	0	17	6	3	66	7
SILVER.																				
An English, or French Crown,	18	0	0	5	0	0	6	8	0	8	9	0	8	3	0	5	0	1	10	0
The Dollar of Spain, Sweden, or Denmark, -	17	6	0	4	6	0	6	0	0	8	0	0	7	6	0	4	8	1	00	0
An English Shilling,	3	18	0	1	0	0	1	4	0	1	9	0	1	8	0	1	1	0	22	2
A Pistareen, - - -	3	11	0	0	10¾	0	1	2	0	1	7	0	1	6	0	0	11	0	20	0

☞ All other gold coins of equal fineness, at 86*cts.* per dwt. and silver at 111*cts.* per oz.

A TABLE OF OTHER FOREIGN COINS, &c.

With their value in Federal Money, as established by a late act of Congress.

	D. cts. m.		D. cts. m.
Pound Sterling, - -	4 44 4	Rupee of Bengal, -	0 55 5
Pound of Ireland, -	4 10 0	The Guilder of the United Netherlands, -	0 39 0
Pagoda of India, - -	1 94 0	Mark Banco of Hamburg,	0 33 5
Tale of China, - -	1 48 0	Livre Tournois of France,	0 18 5
Mill-ree of Portugal, -	1 24 0	Real Plate of Spain, -	0 10 0
Ruble of Russia, - -	0 66 0		

AVOIRDUPOIS WEIGHT.

The denominations are,

16 drams, (marked *dr.*) make	1 ounce,	*oz.*
16 ounces,	1 pound,	*lb.*
28 pounds,	1 quarter,	*qr.*
4 quarters,	1 hundred weight,	*Cwt.*
20 hundred weight,	1 ton,	*T.*

TROY WEIGHT.

The denominations are,

24 grains (*gr.*) make	1 pennyweight,	*dwt.*
20 pennyweights	1 ounce,	*oz.*
12 ounces	1 pound,	*lb.*

APOTHECARIES' WEIGHT.

The denominations are,

20 grains (*gr.*) make	1 scruple	℈
3 scruples	1 dram	ʒ
8 drams	1 ounce	℥
12 ounces	1 pound	℔

LONG MEASURE.

The denominations are,

3 barley-corns (*b. c.*) make	1 inch,	*in.*
12 inches	1 foot,	*ft.*
3 feet	1 yard,	*yd.*
5½ yards	1 rod, pole, or perch,	*P.*
40 poles, or 220*yds.*	1 furlong,	*fur.*
8 furlongs, or 1760*yds.*	1 mile,	*M.*
3 miles	1 league,	*L.*
60 geographic, or } miles, 69½ statute }	1 degree,	*deg.*

360 degrees, the circumference of the earth.

Note.—A fathom is six feet, and is used only to measure the depth of water.

A hand is four inches, and used to measure the height of horses.

LAND OR SQUARE MEASURE.

The denominations are,

144	square inches (marked *in.*) make	1 square foot	*ft.*
9	square feet - - -	1 square yard,	*yd.*
30¼	yards - - - -	1 pole or perch.	*P.*
40	perches - - - - -	1 rood, - -	*R.*
4	roods - - - -	1 acre, - -	*A.*
640	acres - - - -	1 square mile,	*M.*

CLOTH MEASURE.

The denominations are,

2¼	inches (*in.*) make	1 nail, - - - -	*na.*
4	nails - -	1 quarter of a yard, - -	*qr.*
2½	qrs. or 10 nails	1 ell Hamburgh, - -	*E. H.*
3	quarters - -	1 ell Flemish, - - -	*E. Fl.*
4	quarters - -	1 yard, - - - - -	*yd.*
5	quarters - -	1 ell English or French,	*E. E., E. F.*

LIQUID MEASURE.

The denominations are,

4	gills (*gi.*) make	1 pint, -	*pt.*
2	pints - -	1 quart, -	*qt.*
4	quarts - -	1 gallon, -	*gal.*
31½	gallons - -	1 barrel, -	*bar.*
42	gallons - -	1 tierce,	*tier.*
63	gallons - -	1 hogshead,	*hhd.*
84	gallons - -	1 puncheon,	*pun.*
2	hogsheads, -	1 pipe or butt,	*p.* or *b.*
2	pipes or 252*gals.*	1 tun, -	*T.*

DRY MEASURE.

The denominations are,

2	pints (*pt.*) make	1 quart,	*qt.*
8	quarts - -	1 peck,	*pe.*
4	pecks - -	1 bushel,	*bu.*

MOTION, OR CIRCLE MEASURE.

The denominations are,

60	seconds (″) make	1 minute, -	′
60	minutes - -	1 degree, -	°
30	degrees - -	1 sign, -	*sig.*
12	signs - -	1 revolution or circle.	

TIME.

The denominations are,

60 seconds (marked *sec.*)	make	1 minute,	*min.*
60 minutes		1 hour,	*hr.*
24 hours		1 day,	*d.*
7 days		1 week,	*w.*
4 weeks		1 month,	*mo.*
13 lunar months, 1 day, and 6 hours, or 365 days and 6 hours		1 year,	*Y.*

The year is also divided into 12 calendar months, as follows:

The fourth, eleventh, ninth, and sixth,
Have thirty days to each affix'd,
And ev'ry other thirty-one,
Except the second month alone,
Which has but twenty-eight in fine,
Till leap-year gives it twenty-nine.

◆

COMPOUND ADDITION.

Compound Addition is used when the numbers to be added are of different denominations.

Rule.

1. Set the numbers of the same denomination under each other, leaving a space between each of the denominations.

2. Begin at the right-hand column, and add as in simple addition.

3. Divide the amount by as many of that denomination as will make one of the next greater.

4. If there be any remainder, set it down under the column added up; if there be no remainder, set down a cipher.

5. Carry the quotient produced by dividing to the next higher denomination, and proceed in like manner until all the denominations have been added up.

Proof.—As in Simple Addition.

Questions.

What is the use of Compound Addition?

What is to be observed in placing the denominations in Compound Addition?

How do you proceed after placing the denominations under each other?

By what do you divide the amount?

If, after dividing, there is any remainder, what do you do with it; and how do you proceed, if there be no remainder?

What is to be done with the number produced by dividing?

How is Compound Addition proved?

FEDERAL MONEY.

Examples.

	$	*cts.*	*m.*
(1)	6	07	8
	3	09	7
	7	06	3
	9	03	2
	25	27	0

	$	*cts.*	*m.*
(2)	46	75	5
	79	37	8
	43	50	0
	97	37	5

	$	*cts.*
(3)	37	68¾
	95	37½
	43	25
	79	56¼

	$	*cts.*
(4)	72	62½
	85	87½
	20	12½
	45	18¾
	94	37½
	42	68¾
	79	18¾

	$	*cts.*
(5)	54	75
	37	37½
	93	18¾
	149	87½
	503	68¾
	979	12½
	2194	18¾

	$	*cts.*
(6)	29	25
	34	37½
	188	68¾
	265	12½
	1783	18¾
	8579	56¼
	6	87½

7. If I buy 5*lb.* of coffee for $1 18¾*cts.*; 3*lb.* of tea for $2 50*cts.*; 1*lb.* of cloves for 87½*cts.*; 1*oz.* of mace for 93¾*cts.*; 3*lb.* of cinnamon at $1 87½*cts.*; 9*lb.* of raisins for $2 68¾*cts.*; ¼*lb.* of nutmegs for 37½*cts.*; 7*lb.* of candles for 87½*cts.*; and 1*gal.* of wine for $1 93¾*cts.*: what must I pay for them? *Ans.* $13 25*cts.*

8. I have bought 4*yds.* of lace for $5; a veil for $18 50*cts.*; 8*yds.* of silk for $8 87½*cts.*;. 12*yds.* of ribbon for $1 18¾*cts.*; 19*yds.* of linen for $14 50*cts.*; 2 pair of gloves for 87½*cts.*; 3 pair of stockings for $5 37½*cts.*; 9*yds.* of lawn for $7 87½*cts.*; and 6*yds.* of cambric for $20: what will the bill amount to? *Ans.* $82 18¾*cts.*

9. My cook has bought in market a turkey for $1 87½*cts.*; a pair of ducks for $1 68¾*cts.*; a quarter of lamb for 43¾*cts.*; a quarter of veal for $1 37½*cts.*; a piece of beef for 93¾*cts.*; a peck of peas for 56¼*cts.*; a quart of strawberries for 37½*cts.*; a bundle of asparagus for 31¼*cts.*; and a peck of apples for 12½*cts.*: what sum must I give to pay for the articles? *Ans.* 7 68¾*cts.*

STERLING MONEY.

Examples.

	£	*s.*	*d.*
(1)	2	3	4
	7	1	2
	9	7	3
	5	2	2½
	23	13	11½

	£	*s.*	*d.*
(2)	7	9	4½
	13	7	6¾
	4	5	2
	10	18	10¾

	£	*s.*	*d.*
(3)	4	6	4
	47	19	7
	159	5	3
	78	6	11¾

	£	*s.*	*d.*
(4)	565	3	7
	382	13	5
	592	9	2
	856	17	3
	259	9	8

	£	*s.*	*d.*
(5)	142	16	7
	489	3	4
	726	15	9
	573	4	8
	628	12	6

6. Add £763 7*s.* 4*d.*; £39 4*s* 9*d.*; £162 17*s.* 2*d.*; £459 15*s.*; £473 12*s.* 8*d.* together. *Ans.* £1898 16*s.* 11*d.*

7. Add the following sums: viz. £69 18*s.* 7*d.*; £175 2*s.* 6*d.*; £1582 19*s.* 4*d.*; £175 13*s.* 9*d.*; £143 13*s.* 8*d.*; and £212 0*s.* 7*d.* *Ans.* £2359 8*s.* 5*d.*

8. Add £1776 12*s.* 8*d.*; £412 16*s.* 5*d.*; £369 7*s.* 2*d.*; £469 15*s.* 10*d.*; £573 19*s.* 2*d.*; £1987 14*s.* 8*d.*; £4823 15*s.* 11*d.* together. *Ans.* £10414 1*s.* 10*d.*

9. Add £985 4*s.* 9*d.*; £186 13*s.* 4*d.*; £1569 18*s.* 4*d.*; £183 0*s.* 8*d.*; 17*s*, 4*d.*, and 7*d.* together.
Ans. £2925 15*s.* 0*d.*

AVOIRDUPOIS WEIGHT.

	T.	*cwt.*	*qr.*	*lb.*
(1)	15	3	2	15
	4	8	3	9
	82	19	1	10
	163	8	3	17
	34	15	2	24
	300	16	1	19

	T.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
(2)	7	11	2	16	4	13
	15	7	3	8	16	7
	138	19	1	12	8	13
	42	8	3	19	12	4
	357	6	2	8	3	3

3. Add 12*T.* 16*cwt.* 1*qr.* 19*lb.* 15*oz.*; 114*T.* 10*cwt.* 2*qr.* 72*lb.* 4*oz.* 13*dr.*; 72*T.* 4*cwt.* 2*qr.* 24*lb.* 14*oz.* 3*dr.*; 176*T.* 15*cwt.* 3*qr.* 4*lb.* 15*oz.* 11*dr.*
Ans. 376*T.* 7*cwt.* 2*qr.* 6*lb.* 1*oz.* 11*dr.*

4. Add 139*T.* 19*cwt.* 3*qr.* 18*lb.* 13*oz.* 10*dr.*; 1754*T.* 10*cwt.* 2*qr.* 11*lb.* 2*oz.* 14*dr.*; 27*T.* 3*cwt.* 14*lb.* 11*oz.*; 13*cwt.* 13*oz.* *Ans* 1922*T.* 6*cwt.* 2*qr.* 17*lb.* 8*oz.* 8*dr.*

TROY WEIGHT.

	lb.	*oz.*	*dwt*
(1)	47	10	12
	38	8	6
	16	11	4
	7	2	16
	13	9	11
	124	6	9

	lb.	*oz.*	*dwt.*	*gr.*
(2)	185	2	19	20
	56	9	15	6
	1472	11	2	17
	385	0	8	5
	10	8	7	12

3. Add 16*lb.* 4*oz.* 18*dwt.* 6*gr.*; 7*lb.* 9*oz.* 11*dwt.* 22*gr.*; 163*lb.* 7*oz.* 12*dwt.* 18*gr.*; 17*lb.* 13*dwt.*
Ans. 204*lb.* 10*oz.* 15*dwt.* 22*gr.*

4. Add 172*lb.* 11*oz.* 19*dwt.* 22*gr.*; 12*lb.* 4*oz.* 13*dwt.* 12*gr.*; 18*lb.* 5*oz.* 11*dwt.* 20*gr.*; 119*lb.* 11*oz.* 13*dwt.* 18*gr.* 2*dwt.* 13*gr.*; 10*oz.* 20*gr.* *Ans.* 324*lb.* 8*oz.* 2*dwt.* 9*gr.*

APOTHECARIES' WEIGHT.

	℔	℥	ʒ	℈
(1)	6	3	1	2
	19	9	5	1
	182	7	3	2
	57	6	1	0
	40	5	0	0
	306	7	3	2

	℔	℥	ʒ	℈	*gr.*
(2)	84	7	6	0	12
	132	5	0	2	
	16	2	2	2	8
	1427	6	7	0	19
	14	0	6	1	9

3. Add 18℔ 0℥ 1ʒ 0℈ 12*gr.*; 175℔ 10℥ 5ʒ 0℈ 10*gr.*; 472℔ 3℥ 1ʒ 2℈ 3*gr.*; 11℥ 7ʒ 2℈.
Ans. 667℔ 1℥ 7ʒ 2℈ 5*gr.*

4. Add the following sums: viz. 182℔ 3℥ 1ʒ 0℈; 12℔ 1℥ 0ʒ 2℈ 17*gr.*; 17℔ 2℥ 4ʒ 2℈ 15*gr.*; 10℥ 2ʒ 1℈ 19*gr.* *Ans.* 212℔ 5℥ 1ʒ 1℈ 11*gr.*

LONG MEASURE.

	L.	*M.*	*fur.*	*P.*
(4)	5	2	4	17
	16	1	3	10
	72	0	5	24
	526	0	3	12
	834	2	6	34
	38	0	3	12
	1493	2	2	29

	yd.	*ft.*	*in.*
(2)	3	2	11
	1	1	9
	2	0	8
	3	1	10
	2	0	4
	6	2	7

3. Add 172*L.* 2*M.* 3*fur.* 19*P.* 2*yd.* 2*ft.* 4*in.*; 14*P.* 1*yd.* 3*in.*; 1*M.* 2*fur.* 29*P.* 10*in.*; 4*fur.*; 2*fur.* 10*in.*; 3*yd.* 2*ft.* 3*in.* *Ans.* 173*L.* 1*M.* 4*fur.* 23*P.* 2½*yd.* 6*in.*

4. Add 462*L.* 1*M.* 7*fur.* 29*P.* 1*yd.* 1*ft.* 10*in.*; 11*P.* 1*ft.* 10*in.*; 4*L.* 1*M.* 2*fur.* 28*P.* 1*yd.* 2*ft.* 9*in.*; 13*P.*
Ans. 467*L.* 0*M.* 3*fur.* 1*P.* 4*yd.* 0*ft.* 5*in.*

CLOTH MEASURE.

	yds.	*qr.*	*na.*		*E.E.*	*qr.*	*na.*		*E.Fl.*	*qr.*	*na.*
(1)	75	3	2	(2)	72	3	2	(3)	19	2	3
	163	1	3		536	2	1		728	1	2
	245	2	0		847	1	3		142	0	1
	738	3	1		1453	0	2		816	0	0
	1785	2	3		41	2	0		32	1	2
	3009	1	1								

4. Add 19*yds.* 2*qr.* 3*na.*; 14*yds.* 2*qr.* 0*na.*; 32*yds.* 0*qr.* 2*na.*; 3*qr.* 1*na.*; 142*yds.* 3*qr.* 2*na.*

Ans. 210*yds.* 0*qr.* 0*na.*

5. Add 143*E.Fr.* 0*qr.* 3*na.*; 17*E.Fr.* 2*qr.* 2*na.*; 172 *E.Fr.* 1*qr.* 1*na.*; 182*E.Fr.* 1*qr.* 3*na.*; 132*E.Fr.* 3*qr.* 2*na.*; 72*E.Fr.* 1*qr.* 1*na.* *Ans.* 720*E.Fr.* 1*qr.* 0*na.*

LAND MEASURE.

	A.	*R.*	*P.*		*A.*	*R.*	*P.*
(1)	39	2	37	(2)	487	2	17
	62	1	17		25	3	28
	68	0	38		67	0	32
	129	3	12		45	1	16
	532	1	18		26	0	29
	832	2	2				

3. Add 22*A.* 2*R.*; 700*A.* 3*R.* 27*P.*; 47*A.* 5*P.*; 39*A.*; 47*A.* 2*R.* 39*P*; 3*R.* 28*P.* *Ans.* 858*A.* 0*R.* 19*P.*

4. Add 132*A.* 3*R.* 25*P.*; 654*A.* 17*P.*; 462*A.* 3*R.* 25*P.*; 16*A.* 4*P.*; 1665*A.* 3*R.* 38*P.* *Ans.* 2931*A.* 3*R.* 29*P.*

LIQUID MEASURE.

	T	*hhd.*	*gal.*		*hhd.*	*gal.*	*qt.*	*pt.*
(1)	18	2	54	(2)	385	42	3	1
	63	1	39		27	36	2	0
	327	0	4		132	17	0	0
	46	1	19		729	25	0	0
	285	3	28		163	47	2	1
	741	1	18					

3. Add 19*T.* 2*hhd.* 19*gal.*; 45*T.* 1*qt.* 1*pt.*; 3*hhd.* 17*gal.* 2*qt.*; 21*gal.* 1*pt.* *Ans.* 65*T.* 1*hhd.* 58*gal.* 0*qt.* 0*pt.*

4. Add 862*T.* 1*hhd.* 1*qt.*; 32*gal.* 1*pt.*; 37*gal.* 2*qt.*; 32*gal.* 1*qt.* 0*pt.*; 2*hhd.* 1*pt.*

Ans. 863*T.* 0*hhd.* 39*gal.* 1*qt.* 0*pt.*

DRY MEASURE.

	Bu.	*pe.*	*qt.*
(1)	37	2	1
	182	3	2
	423	1	0
	162	3	1
	357	0	2
	1163	1	6

	Bu.	*pe.*	*qt.*	*pt.*
(2)	47	2	4	1
	635	0	3	0
	247	3	0	1
	285	0	2	0
	734	2	5	0

3. Add 754*bu.* 2*pe.* 5*qt.*; 469*bu.* 2*qt.*; 385*bu.* 2*pe.* 7*qt.* 1*pt.*; 375*bu.* 1*pt.*; 3*pe.* 2*qt.* *Ans.* 1985*bu.* 1*pe.* 1*qt.*

4. Add 144*bu.* 3*pe.* 2*qt.* 1*pt.*; 1*pe.* 2*qt.*; 3*qt.* 1*pt.*; 462*bu.* 3*pe.* 1*pt.*; 72*bu.* 5*qt.* 1*pt.* *Ans.* 680*bu.* 6*qt.* 0*pt.*

TIME.

	Y.	*M.*	*we.*	*d.*	*h.*
(1)	17	11	3	5	20
	172	9	2	3	17
	35	7	3	6	22
	4	10	0	4	16
		6	0	3	19
	231	6	3	3	22

	H.	*min.*	*sec.*
(2)	20	52	40
	122	12	35
	68	9	17
	135	17	12
	24	35	28
	371	7	12

3. Add 172*Y.* 1*we.* 4*h.* 52*sec.*; 34*min.* 18*sec.*; 15*Y.* 4*M.* 5*d.* 3*h.* 27*min.*; 1*we.* 3*d.* 21*h.* 35*min.* 18*sec.*

Ans. 187*Y.* 4*M.* 3*we.* 2*d.* 5*h.* 37*min.* 28*sec.*

4. Add 462*Y.* 4*M.* 5*h.* 37*min.* 24*sec.*; 62*Y.* 11*h.* 24*sec.*; 1*we.* 5*d.* 13*min.*; 6*M.* 1*we.* 4*d.* 13*h.* 12*min.* 37*sec.*

Ans. 524*Y.* 10*M.* 3*we.* 3*d.* 6*h.* 3*min.* 25*sec.*

MOTION, OR CIRCLE MEASURE.

	Sig.	°	′	″		*Sig.*	°	′	″
(1)	1	5	37	42	(2)	2	7	32	16
	1	7	26	12		0	5	27	24
	4	8	26	11		1	6	17	13
	1	4	32	17		0	7	38	24
	3	6	0	47		4	5	42	19
	11	2	3	9					

3. Add 5*sig.* 10° 46′ 38″; 11° 37′ 18″; 1*sig.* 47′ 12′; 18″; 2*sig.* 52″; 1*sig.* 15° 12′ 23″; and 11° 57′ 29″ together. *Ans.* 10*sig.* 20° 22′ 10″.

4. Add 45′; 1*sig.* 9° 18″; 14° 21′ 34″; 2*sig.* 8° 13′ 54″; 4*sig.* 7° 12′ 19″; and 47′ 32″ together.
Ans. 8*sig.* 10° 20′ 37″.

Application.

1. Bought groceries to the amount of $375 45*cts.*; linen to the amount of $142 37½*cts.*; cloth to the amount of $1375 56¼*cts.*: what must I pay for the whole?
Ans. $1893 38¾*cts.*

2. Bought 6 pieces of linen: the first contains 57*yds.* 2*qr.*; the second, 29*yds.* 3*qr.* 2*na.*; the third, 45*yds.* 1*qr.*; the fourth, 32*yds.* 3*qr.* 1*na.*; and the other two, each 38*yds.* 2*qr.*: what are the number of yards in the whole?
Ans. 242*yds.* 1*qr.* 3*na.*

3. There are four bags of corn: the first contains 2*bu.* 2*pe.*; the second, 3*bu.* 3*pe.* 5*qt.*; the third, 3*bu.* 1*pe.* 1*qt.*; the fourth, 2*bu.* and 4*qt.*: how much is in the four bags?
Ans. 11*bu.* 3*pe.* 2*qt.*

4. A man has three farms: the first contains 142*A.* 2*R.*; the second, 32*A.* 3*R.* 12*P.*; the third, 108*A.* 3*R.* 18*P.*: how many acres are there in all? *Ans.* 284*A.* 0*R.* 30*P.*

5. There are three pieces of tape: the first measures 15*yds.* 3*qr.*; the second, 18*yds.* 1*qr.* 2*na.*; the third, 25*yds.* 3*qr.* 2*na.*: how many yards are there in the three pieces? *Ans.* 60*yds.*

6. If a man on a journey travels the first day 43*M.* 3*fur.*; the second, 29*M.* 34*p.*; the third, 57*M.* 2*fur.* 32*p.*; and the fourth, 12*M.* 3*fur.* 18*p.*: how many miles did he travel in the four days? ***Ans.*** 142*M.* 2*fur.* 4*p.*

7. Suppose a man to have 5 granaries, three of which contain each 756*bu.* 2*pe.*, and the other two each 854*bu.* 5*qt.*: how many bushels do the five granaries contain? ***Ans:*** 3977*bu.* 3*pe.* 2*qt.*

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COMPOUND MULTIPLICATION.

Compound Multiplication is used when numbers of different denominations are to be multiplied.

Rule.

1. Set down the number to be multiplied, and under its right-hand denomination set the multiplier.
2. Multiply the right-hand denomination by the multiplier.
3. Divide the amount by as many of the right-hand denomination as make one of the next higher denomination.
4. If there be any remainder, set it down under the denomination the amount of which you have divided; if there be no remainder, set down a cipher.
5. Carry the number, produced by dividing, to the next higher denomination, and proceed in the same manner until all the denominations have been multiplied.

Proof.—As in Simple Multiplication.

Questions.

When is Compound Multiplication used?

Under what part of the number to be multiplied do you place the multiplier?

How do you proceed after having set down the number to be multiplied, and the multiplier under its right-hand denomination?

By what do you divide the amount?

If there be a remainder, what is to be done; and if there be no remainder?

What is to be done with the number produced by dividing?

How is Compound Multiplication to be proved?

Examples.

FEDERAL MONEY.

Note.—When operations are to be performed in Federal money, owing to the decimal nature of that Currency, it may either be Simple or Compound, as may be found most convenient.

(1)
$ cts. m.
9 03 2
4
36 12 8

(2)
$ cts. m.
104 33 3
9
938 99 7

(3)
$ cts.
18 50
4
74 00

(4)
$ cts.
26 $18\frac{3}{4}$
6

(5)
$ cts. m.
100 40 4
10

(6)
$ cts.
56 $18\frac{3}{4}$
9

		$	cts.	m.				$	cts.	m.
7.	Multiply	25	37	5	by	8	Product	203	00	0
8.	—	565	$62\frac{1}{2}$		by	12	—	6787	50	0

ENGLISH MONEY.

(1)
£ s. d.
246 13 $3\frac{3}{4}$
11
2713 6 $5\frac{1}{4}$

(2)
£ s. d.
14 6 $0\frac{1}{4}$
9

(3)
£ s. d.
111 11 $10\frac{1}{2}$
10

		£	s.	d.			£	s.	d.
4.	Multiply	37	6	$9\frac{1}{2}$	by	5	186	13	$11\frac{1}{2}$
5.	—	56	8	$7\frac{3}{4}$	by	9	507	17	$9\frac{3}{4}$

AVOIRDUPOIS WEIGHT.

	T.	*cwt.*	*qr.*	*lb.*		*T.*	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*		*qr.*	*lb.*	*oz.*	*dr*
(1)	8	6	1	16	(2)	6	14	2	7	5	2	(3)	3	16	7	8
				3							4					10
	24	19	0	20												

4. Bought 10 barrels of sugar, each weighing 1*cwt.* 2*qr.* 6*lb.*: what is the weight of the whole? *Ans.* 15*cwt.* 2*qr.* 4*lb.*

5. Multiply 4*cwt.* 3*qr.* 17*lb.* by 11. *Ans.* 53*cwt.* 3*qr.* 19*lb.*

TROY WEIGHT.

(1)			(2)				(3)				(4)		
lb.	*oz.*	*dwt.*	*lb.*	*oz.*	*dwt.*	*gr.*	*lb.*	*oz.*	*dwt.*	*gr.*	*lb.*	*oz.*	*dwt.*
67	5	16	43	0	8	10	113	6	0	6	17	9	14
		2				4				6			10
134	11	12											

5. Multiply 41*lb.* 6*oz.* 18*dwt.* 2*gr.* by 7.
Ans. 291*lb.* 0*oz.* 6*dwt.* 14*gr.*

6. Multiply 91*lb.* 4*oz.* 14*dwt.* 16*gr.* by 8.
Ans. 731*lb.* 1*oz.* 17*dwt.* 8*gr.*

APOTHECARIES' WEIGHT.

	℔	℥	ʒ	℈		℔	℥	ʒ	℈	*gr.*		℔	℥	ʒ	℈	*gr.*
(1)	4	8	2	1	(2)	53	10	0	2	12	(3)	17	5	6	1	4
				5						9						12
	23	5	3	2												

4. Multiply 76℔ 4℥ 1ʒ 2℈ by 9.
Ans. 687℔ 1℥ 7ʒ 0℈.

5. There are 11 parcels, each weighing 95℔ 1℥ 2ʒ 1℈ 11*gr.*: what is their weight? *Ans.* 1046℔ 2℥ 3ʒ 2℈ 1*gr.*

LONG MEASURE.

	Deg.	*M.*	*fur.*	*p.*		*L.*	*M.*	*fur.*	*p.*		*M.*	*fur.*	*p.*	*yd.*	*ft.*	*in.*
(1)	8	1	3	36	(2)	4	2	2	29	(3)	18	3	20	1	2	10
				12					7							5
	96	17	6	32												

4. Multiply 6*deg*. 40*m*. 7*fur*. by 10.
Ans. 66*deg*. 48*m*. 6*fur*.

5. Multiply 44*m*. 6*fur*. 20*p*. by 7.
Ans. 313*m*. 5*fur*. 20*p*.

CLOTH MEASURE.

yd. qr. na.	*E.E.qr.na.*	*E.Fl.qr.na.*	*E.Fr.qr.na.*
(1) 20 2 3	(2) 37 4 2	(3) 18 0 3	(4) 14 1 3
6	8	12	9
124 0 2			

5. If 19*yd*. 1*qr*. 2*na*. be multiplied by 5, what number of yards will there be? *Ans*. 96*yds*. 3*qr*. 2*na*.

6. Multiply 56*E.E*. 3*qr*. by 9. *Ans*. 509*E.E*. 2*qr*.

LAND MEASURE.

A. R. P	*A. R. P.*	*A. R. P.*
(1) 49 2 17	(2) 19 3 20	(3) 10 0 33
2	6	9
99 0 34		

4. How many acres will 10 men reap in one day, allowing them 1*A*. 3*R*. 11*P*. each? *Ans*. 18*A*. 0*R*. 30*P*.

5. Multiply 63*A*. 3*R*. 18*P*. by 11.
Ans. 702*A*. 1*R*. 38*P*.

LIQUID MEASURE.

hhd.gal. qt.	*T.hhd.gal. qt. pt.*	*Pi.hhd.gal. qt. pt.*
(1) 8 43 2	(2) 1 2 16 3 1	(3) 4 1 19 3 1
4	10	5
34 48 0		

4. Multiply 3*T*. 2*hhd*. 50*gal*. 2*qt*. by 8.
Ans. 29*T*. 2*hhd*. 26*gal*. 0*qt*.

5. Multiply 4*hhd*. 41*gal*. 1*pt*. by 10.
Ans. 46*hhd*. 33*gal*. 1*qt*. 0*pt*.

DRY MEASURE.

	bu.	*pe.*	*qt.*	*pt.*
(1)	180	5	2	1
				8
	1450	2	4	0

	bu.	*pe.*	*qt.*	*pt.*
(2)	1	3	3	2
				4

	bu.	*pe.*	*qt.*	*pt.*
(3)	110	3	0	2
				4

4. Let 44*bu.* 1*pt.* be multiplied by 7.
Ans. 308*bu.* 0*pe.* 3*qt.* 1*pt.*

5. Multiply 3*pe.* 1*qt.* by 9. *Ans.* 7*bu.* 0*pe.* 1*qt.*

TIME.

	Y.	*M.*	*w.*	*d.*
(1)	6	7	2	5
				2
	13	3	1	3

	Y.	*M.*	*w.*	*d.*	*h.*	*min.*	*sec.*
(2)	17	8	2	6	4.	40	18
							6

	W.	*d.*	*h.*
(3)	3	5	22
			12

4. Multiply 7*yr.* 4*w.* and 4*d.* by 9.
Ans. 63*Y.* 10*m.* 1*w.* 1*d.*

5. Multiply 15*yr.* 2*m.* 6*d.* by 8.
Ans. 121*Y.* 4*m.* 2*w* 6*d.*

Rule 2.

When the multiplier exceeds 12, but is the exact product of any two figures in the multiplication table, the operation must be performed by the following method:

Multiply the given sum by one of the figures, and that product by the other.

Question.

Repeat the Rule for performing operations in Compound Multiplication, when the multiplier is the exact product of any two figures in the multiplication table.

Examples.

	$	cts.				£	s.	d.	
1. Multiply	75	12½	by 25		2.	37	10	6¾	by 48
		5						6	
	375	62½				225	3	4½	
		5						8	
	1878	12½				1801	7	0	

	$	cts.	m.				$	cts.	m.
3. Multiply	66	37	5	by	36	*Ans.*	2389	50	0
4.	44	25	3	—	56		2478	16	8
5.	12	18¾		—	96		1170	00	0
	£	s.	d.				£	s.	d.
6.	45	6	9½	—	120		5440	15	0
7.	96	12	3¾	—	144		13912	13	0
	A.	*R.*	*P.*				*A.*	*R.*	[illegible]
8.	47	3	20	—	54		2585	1	[illegible]
	M.	*F.*	*P.*				*M.*	*F.*	[illegible]
9.	48	7	25	—	88		4307	7	[illegible]
	℔	℥	ʒ				℔	℥	ʒ
10.	56	9	6	—	84		4772	[illegible]	[illegible]

Rule 3.

When the multiplier is not the exact product of [illegible] two figures in the multiplication table, work by the foll[illegible]ing Rule:

1. Multiply by the two figures in the multiplicati[illegible] table, the product of which comes nearest to, but l[illegible] than, the given multiplier.

2. Multiply the given sum by the difference betw[illegible] the product of the figures by which you multiplied and [illegible] given multiplier.

3. Add the two products together.

Questions.

When the multiplier is not the exact product of any of the figures in the multiplication table, what is first to be done?

When you have multiplied by the two figures which come nearest to the given multiplier, what is then to be done?

How do you complete the operation?

Examples.

	$	*cts.*	*m.*		£	*s.*	*d.*	
1. Multiply	4	75	8	by 29—1	3	7	6½	by 59—3
			4				7	
	19	03	2		23	12	9½	
			7				8	
	133	22	4		189	2	4	
	4	75	8		10	2	7½	
	137	98	2		199	4	11½	

			$	*cts.*					$	*cts.*
2.	Multiply		7	87½	by	47	*Ans.*		370	12½
3.			28	68¾	—	68			1950	75
4.			49	75	—	87			4328	25
5.			94	18¾	—	31			2919	81¼
6.			42	31¼	—	58			2454	12½
		£	*s.*	*d.*				£	*s.*	*d.*
7.		28	7	6½	by	29		822	18	8½
8.		34	8	4¾	—	67		2306	2	6¼
9.		7*cwt.*	3*qr.*	22*lb.*	—	51		405*cwt.*	1*qr.*	2*lb.*
10.		12*lb.*	5*oz.*	8*dwt.*	—	39		485*lb.*	6*oz.*	12*dwt.*
11.		4*m.*	6*fur.*	21*p.*	—	87		418*m.*	7*fur.*	27*p.*

Rule 4.

When the multiplier exceeds the product of any two figures in the multiplication table, the operation must be performed by the following Rule:

1. Multiply the given sum by 10, as many times less one as there are figures in the multiplier.

2. Multiply that product by the left-hand figure of the multiplier.

3. Multiply the given sum by the unit figure of the multiplier; the product of the first 10, by the ten figure of the multiplier; the second 10, by the second figure of the multiplier; and so on, until you have multiplied by all the figures, (except the left-hand one.)

4. Add all the products together.

Questions.

How do you first proceed, when the given multiplier exceeds the product of any two figures in the multiplication table?

After you have multiplied by 10, as many times less one as there are figures in the multiplier, by what do you then multiply?

After having multiplied that product by the left-hand figure of the multiplier, what is to be done with the products?

Examples.

	$	*cts.*	£	*s.*	*d.*
1. Multiply	5	$18\frac{3}{4}\times 5$ by 325	1	2	$6\frac{1}{4}\times 6$ by 496
		10			10
	51	$87\frac{1}{2}\times 2$	11	5	$2\frac{1}{2}\times 9$
		10			10
	518	75	112	12	1
		3			4
	1556	25	450	8	4
	25	$93\frac{3}{4}$	6	15	$1\frac{1}{2}$
	103	75	101	6	$10\frac{1}{2}$
	1685	$93\frac{3}{4}$	558	10	4

	$	*cts.*				$	*cts.*
2. Multiply	1	$56\frac{1}{2}$	by	456	*Ans.*	713	64
3.	2	$87\frac{1}{2}$	—	576		1656	00
4.	4	$31\frac{1}{4}$	—	679		2928	$18\frac{3}{4}$
5.	18	$93\frac{3}{4}$	—	457		8654	$43\frac{3}{4}$
6.	25	$43\frac{3}{4}$	—	879		22359	$56\frac{1}{4}$

		$	cts.					$	cts.	
7.	Multiply		1¾		by	2266	*Ans.*	39	65½.	
8.		10	16½		—	939		9544	93½	
		£	s.	d.				£	s.	d.
9.		37	18	6¼	by	375.		14222	5	3¾
10.		48	14	2½	—	489		23819	7	10½
11.		64	2	8	—	555		35594	0	0
12		58	9	6¾	—	396		23157	6	9
		M	*F.*	*P.*				*M.*	*F.*	*P.*
13.		25	3	18	—	1265		32170	4	10
		F.	*in*	*b.c.*				*F.*	*in.*	*b.c.*
14.		48	4	2	—	2587		125182	0	2
		yd.	*qr.*	*na.*				*yd.*	*qr.*	*na.*
15.		22	2	1	—	3204		72290	1	0
		hhd.	*gal.*	*qt.*				*hhd.*	*gal.*	*qt.*
16.		4	37	2	—	4250		19529	48	0

Application.

1. Sold 5*cwt.* of tobacco, at $12,50 per *cwt.*: what will the whole amount to? *Ans.* $62,50.

2. If I buy 9 yards of muslin at $1,07 per yard, what must I pay for it? *Ans.* $9,63.

3. When 1 cord of wood costs $5,62¼, what will be the price of 12 cords at the same rate? *Ans.* $67,47.

4. Bought 24 bushels of wheat, at $1,12½ per bushel: what is the amount? *Ans.* $27.

5. What is the value of a bag of coffee, weighing 63 pounds, at 2*s.* 2*d.* per pound? *Ans.* £6 16*s.* 6*d.*

6. A merchant bought 2 pieces of cloth, the one containing 38 yards, and the other 26 yards: what is the amount of the two pieces, at $3,87½ per yard? *Ans.* $248.

7. What cost a box of sugar, weighing 106 pounds, at 15¼*cts.* per pound? *Ans.* $16,16½.

8. What must be paid for a quantity of cheese, weighing 132 pounds, at 1*s.* 3*d.* per pound? *Ans.* £8 5*s.*

9. If a man's income be $9,10 per day, what will he receive a year? *Ans.* $3321,50.

10. If I hold 325 acres of land, at a yearly rent of 9*s.* 6*d.* per acre, what does my rent amount to? *Ans.* £154 7*s.* 6*d.*

11. Bought 217 gallons of brandy, at $1,18¾ per gallon, and sold it for $1,37½ per gallon; what was the amount paid for the whole, the sum it sold for, and the gain? *Ans.* Prime cost $257,68¾; sold for $298,37½; gain $40,68¾.

◆

COMPOUND SUBTRACTION.

Compound Subtraction is used when numbers of different denominations are to be subtracted.

Rule.

1. Set down the larger number, and under it the smaller, observing that the denominations of the smaller number are placed under like denominations of the larger number.

2. Begin at the right-hand denomination, and subtract the lower from the upper, if the upper denomination is larger than the lower, and set down the remainder.

3. But if the upper denomination is less than the lower, add to the upper denomination as many as make one of the next greater denomination; then subtract the lower denomination from the amount, and set down the remainder, until all the denominations have been subtracted.

Proof.—The same as in Simple Subtraction.

Questions.

When is Compound Subtraction used?

How do you set down sums in Compound Subtraction?

How do you proceed after having properly set down the two numbers, and the upper denomination is greater than the lower?

How do you proceed if the upper denomination is less than the lower?

How is Compound Subtraction proved?

Examples.

FEDERAL MONEY.

	$	cts.	m		$	cts.	m		$	cts.		$	cts.
(1)	10	10	9	(2)	24	60	7	(3)	600	62½	(4)	110	18
	4	12	6		19	30	0		1	75		99	10
	5	98	3										

	$	*cts.*	*m.*		$	*cts.*		$	*cts.*		$	*cts.*
(5)	960	10	2	(6)	449	62½	(7)	1866	00	(8)	104	06¼
			9		1	06¾		278	11¾			9¾

9. Take $1011 12*cts.* 5*m.* from $4010 14*cts.* 4*m.*

Ans. $2999 1*ct.* 9*m.*

10. Lent a man $400: he now returns $211 12½*cts.*: how much is still unpaid? *Ans.* $188 87½*cts.*

ENGLISH MONEY.

	£	*s.*	*d.*		£	*s.*	*d.*		£	*s.*	*d.*
(1)	146	19	10½	(2)	47	6	7¾	(3)	419	7	6
	7	19	9¾		28	5	10½		227	8	9¼
	139	0	0¾								

4. Subtract £200 9*s.* from £1000 11*s.* 11¾*d.*

Ans. £800 2*s.* 11¾*d.*

5. I have a purse of money containing £1000 2*s.* 4½*d.*: if I take out £60 7*s.* 8¾*d.*, what sum will be left?

Ans. £939 14*s.* 7¾*d.*

AVOIRDUPOIS WEIGHT.

	Cwt.	*qr.*	*lb.*		*T.*	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*		*cwt.*	*qr.*	*lb.*	*oz.*
(1)	14	1	19	(2)	18	16	1	16	9	2	(3)	9	3	20	2
	6	3	11		0	19	3	20	0	6			2	23	5
	7	2	8												

4. From 14*T.* 10*cwt.* 2*qr.* 16*lb.* subtract 11*lb.*

Ans. 14*T.* 10*cwt.* 2*qr.* 5*lb.*

5. Bought 400*cwt.* of sugar; sold 2*cwt.* 3*qr.* 14*lb.*: what quantity is left? *Ans.* 397*cwt.* 0*qr.* 14*lb.*

TROY WEIGHT.

	lb.	*oz.*	*dwt.*	*gr.*		*lb.*	*oz.*	*dwt.*	*gr.*		*lb.*	*oz.*	*dwt.*	*gr.*
(1)	10	6	18	0	(2)	8	3	0	2	(3)	106	0	0	15
	4	0	2	20		2	1	18	6		10	6	2	20
	6	6	15	4										

4. Subtract 14*lb.* 6*oz.* 11*dwt.* from 22*lb.* 12*dwt.* 6*gr.*

Ans. 7*lb.* 6*oz.* 1*dwt.* 6*gr.*

5. From 16*lb.* take 12*lb.* 11*oz.* 10*dwt.* 11*gr.*

Ans. 3*lb.* 0*oz.* 9*dwt.* 13*gr.*

APOTHECARIES' WEIGHT.

	℔	℥	ʒ
(1)	1090	1	6
	106	2	7
	983	10	7

	℔	℥	ʒ	℈	*gr.*
(2)	48	9	6	1	4
	1	10	0	2	8

3. From 59℔ 1℥ 2ʒ take 53℔ 7℥ 5ʒ. *Ans.* 5℔ 5℥ 5ʒ.

4. Subtract 14℔ 9℥ 1ʒ from 69℔. *Ans.* 54℔ 2℥ 7ʒ.

CLOTH MEASURE.

	yd.	*qr.*	*na.*
(1)	176	2	3
	89	3	2
	86	3	1

	yd.	*qr.*	*na.*
(2)	950	1	2
	19	2	3

	yd.	*qr.*	*na.*
(3)	49	0	2
	16	2	1

	E.E.	*qr.*	*na.*
(4)	66	4	0
	17	0	2

	E.Fr.	*qr.*
(5)	44	1
	19	2

	E.Fl.	*qr.*
(6)	963	1
	174	2

7. Bought 17*yd.* 2*qr.* of Canton crape: 2*yd.* 3*qr.* 1*na.* being damaged, how much was good? *Ans.* 14*yd.* 2*qr.* 3*na.*

8. From 75*yd.* 3*qr.* 1*na.* take 1*na.* *Ans.* 75*yd.* 3*qr.*

LONG MEASURE.

	L.	*M.*	*fur.*	*po.*	*yd.*	*ft.*	*in.*	*b.c.*
(1)	6	2	5	0	0	2	4	1
	1	1	4	20	0	1	7	2
	5	1	0	20	0	0	8	2

	Deg.	*M.*	*fur.*	*po.*
(2)	20	50	4	20
	11	56	0	30

3. A man going a journey travels the first day 43*M.* 5*fur.* 20*per.*; on the second, 32*M.* 4*fur.*; how much more did he travel the first day than the second? *Ans.* 11*M.* 1*fur.* 20*p.*

LAND MEASURE.

	A.	*R.*	*P.*
(1)	96	2	16
	87	3	18
	8	2	38

	A.	*R.*	*P.*
(2)	500	2	10
	111	3	9

	A.	*R.*	*P.*
(3)	69	1	3
	17	3	2

LIQUID MEASURE.

	T.	*hhd.*	*gal.*	*qt.*	*pt.*
( )	2	3	50	1	0
	1	2	16	3	1
	1	1	33	1	1

	T.	*hhd.*	*gal.*	*qt.*	*pt.*
(2)	100	1	19	2	1
	99	1	28	3	1

3. If I purchase 2*hhd.* of wine, and to oblige a friend send him 29*gal.*, what quantity have I left? *Ans.* 1*hhd.* 34*g.*

4. Bought 1 pipe of wine, 4*hhd.* of brandy, 2 barrels of beer; I have since sold 93 gallons of wine, 29 of brandy, 1 barrel of beer: how much of each have I remaining?
Ans. 33*gal.* of wine, 223*gal.* brandy, and 31½*gal.* beer.

DRY MEASURE.

	bu.	*pe.*	*qt.*
(1)	66	3	2
	39	3	6
	26	3	4

	bu.	*pe.*	*qt.*	*pt.*
(2)	10	0	0	1
	9	2	6	1

	bu.	*pe.*	*qt.*	*pt.*
(3)	695	3	0	1
	589	3	5	0

4. If from 490*bu.* 0*pe.* 1*qt.* 1*pt.*, 8*bu.* 0*pe.* 2*qt.* 1*pt.* be taken, what number will remain? *Ans.* 481*bu.* 3*pe.* 7*qt.*

5. Subtract 146*bu.* 3*pe.* 2*qt.* 1*pt.* from 600*bu.* 2*pe.* 7*qt.* 1*pt.* *Ans.* 453*bu.* 3*pe.* 5*qt.*

TIME.

(1)

Y.	*M.*	*w.*	*d.*	*ho.*	*min.*	*sec.*
6	0	3	1	3	40	20
1	0	2	6	2	57	36
5	0	0	2	0	42	44

(2)

H.	*min.*	*sec.*
16	29	33
7	36	44

(3)

Y.	*M.*	*w.*
18	11	2
9	10	3

4. From 900*Y.* take 111*Y.* 6*m.* 2*w.* and 6*da.*
Ans. 788*Y.* 6*m.* 1*w.* 1*da.*

5. If I take 1*Y.* 1*M.* 1*w.* 1*da.* 1*ho.* from 6*Y.* what space of time will still remain? *Ans.* 4*Y.* 11*M.* 2*w.* 5*d.* 23*h.*

The intervening time between two given Calendar dates, may be readily found by the following

Rule.

1. Set down the subsequent or greater date, in the order of years, months, days; and under it, the prior or less

date, in the same order, numbering the months according to their place in the Calendar.

2. Begin with the days; and when the lower number of days is greater than the upper, subtract it from the number of days contained in the month mentioned in the lower or prior date, and add the difference to the number of days contained in the upper or greater date, which sum set down, and carry one to the months of the lower date.

3. Then if the months of the lower or less date be greater than the months of the upper or greater date, subtract the number of months contained in the lower or less date from the number of months in a year, and add the difference to the number of months in the upper or greater date, and carry one to the years of the lower or less date.

Questions.

How do you set down two given Calendar dates, in order to find the difference between them?

After having set down the two given dates, where do you begin to subtract? and how do you proceed when the number of days in the less date is greater than the number of days in the greater date?

Examples.

1. John was born on the 26th day of January, 1824, and James on the 23d day of September, 1827: what is the difference of their ages?

Yrs.	*mo.*	*d.*
1827	9	23
1824	1	26
3	7	28

Note.—January is the first month in the Calendar, and September the ninth.

2. William was born on the 11th day of August, 1813, and Joseph on the 5th day of July, 1827: how much older is William than Joseph?

Yrs.	*mo.*	*d.*
1827	7	5
1813	8	11
13	10	25

3. A man gave his note on the 13th day of November, 1820, and paid it on the 11th day of January, 1828: for what period of time is the interest to be computed?

Yrs.	*mo.*	*d.*
1828	1	11
1820	11	13
7	1	28

MOTION, OR CIRCLE MEASURE.

	sig.	°	′	″		*sig.*	°	′	″		*sig.*	°	′	″
(1)	11	0	1	20	(2)	9	7	40	8	(3)	10	10	16	19
	8	9	8	39		7	9	57	19		7	24	37	59
	2	20	52	41										

4. Take 9*sig.* 7′ 20″, from 11*sig.* 2° 5′ and 14″.
Ans. 2*sig.* 1° 5′ 54″.

Application.

1. Sold 6*ft.* of gold chain at $2,75 per foot; a gold ring for $4,50; a pair of ear-rings for $12,00; owing to some defect, the ring has been returned: I desire to know the whole amount, and how much I must receive?
Ans. Whole amount $33,00, receive $28,50.

2. Bought 2 doz. pair of stockings at 75*cts.* per pair; 16 yards of linen at 87½*cts.* per yard; 28 yards domestic muslin at 22*cts.* per yard; and 5 pair of gloves at 31¼*cts.* per pair; and I deliver to the merchant a fifty-dollar note, from which to take the amount: what change must be returned to me? *Ans.* $10,27¾.

3. I have several tracts of land; one of them contains 690*A.* 2*R.* 16*P.*; another 400*A.*; and two others each 63*A.* 3*R.* 24*P.*; if I now sell 200*A.* what number of acres have I left? *Ans.* 1018*A.* 1*R.* 24*P.*

4. Sent my clerk to collect money: from one person he collected £55 6*s.* 7*d.*; from another, £41 4*s.* 6*d.*; from another, £75; returning home, he lost £40 6*s.*: how much did he collect, and what sum have I now?
Ans. Collected £171 11*s.* 1*d.*; I have £131 5*s.* 1*d.*

5. Bought 400*bu.* 3*pe.* of wheat; 160*bu.* of rye; 150*bu.* 2*pe.* of oats; I have sold 225*bu.* 1*pe.* of wheat; 37*bu.* 2*pe.* of rye; 78*bu.* 3*pe.* of oats: how many bushels of each have I on hand?
Ans. { 175*bu.* 2*pe.* wheat;
122*bu.* 2*pe.* rye;
and 71*bu.* 3*pe.* oats.

COMPOUND DIVISION.

COMPOUND DIVISION is used when a number containing different denominations is to be divided.

When the divisor is less than 12, work by the following

Rule.

1. Set down the number to be divided, with the divisor on the left of the highest denomination.

2. Divide the highest denomination by the divisor, and set down the quotient.

3. If there is a remainder, multiply it by as many of the next denomination as make one of that denomination from which the remainder is derived, and add the next denomination to the product, dividing the amount as before, proceeding in the same manner with all the denominations.

When the divisor exceeds 12, but is the exact product of two figures in the multiplication table, divide first by the one and then by the other, as in simple division.

When the divisor exceeds 12, and is not the exact product of any of the figures in the multiplication table, the operation must be performed by Long Division.

Proof.—As in Simple Division.

Questions.

When is Compound Division to be used?

Where is the divisor to be placed?

If when you divide the highest denomination by the divisor a remainder occurs, how do you proceed?

When the divisor exceeds 12, but is the exact product of any two figures in the multiplication table, how may the operation be performed?

How must the operation be performed when the divisor exceeds 12, and is not the exact product of any two figures in the multiplication table?

How is Compound Division proved?

Examples.

1. Divide 186 dollars by 2.

$		$	*cts.*
2)186		2)798	32
Ans. 93 dollars.	*Ans.*	399	16

		$	*cts.*					$	*cts.*	
3.	Divide	366	$18\frac{3}{4}$		by	3	*Ans.*	122	$06\frac{1}{4}$	
4.	—	384	$87\frac{1}{2}$		by	6	—	64	$14\frac{1}{2}+2.$	
5.	—	496	75		by	8	—	62	$09\frac{1}{4}+4.$	
6.	—	587	$68\frac{3}{4}$		by	9	—	65	$29\frac{3}{4}+4.$	
7.	—	976	$43\frac{3}{4}$		by	11	—	88	$76\frac{1}{2}+9.$	
8.	—	1979	$33\frac{1}{3}$		by	12	—	164	$94\frac{1}{3}+4.$	
		£	*s.*	*d.*				£	*s.*	*d.*
9.	Divide	560	9	7	by	3	*Ans.*	186	16	$6\frac{1}{4}+1.$
10.	—	475	19	$9\frac{3}{4}$	by	5	—	95	3	$11\frac{1}{2}+1.$
11.	—	596	15	$6\frac{1}{2}$	by	8	—	74	11	$11\frac{1}{4}+2.$
12.	—	756	4	$11\frac{3}{4}$	by	12	—	63	0	$4\frac{3}{4}+11.$
		Cwt.	*qr.*	*lb.*				*Cwt.*	*qr.*	*lb.*
13.	Divide	45	3	27	by	5	*Ans.*	9	0	22+1.
14.	—	10	0	15	by	9	—	1	0	14+1.
		yd.	*qr.*	*na.*				*yd.*	*qr.*	*na.*
15.	Divide	44	1	2	by	7	*Ans.*	6	1	1+3.
16.	—	56	3	3	by	11	—	5	0	2+9.
		M.	*fur.*	*p.*				*M.*	*fur.*	*p.*
17.	Divide	105	5	22	by	12	*Ans.*	8	6	18+6.
18.	—	45	7	18	by	6	—	7	5	9+4.

When the divisor exceeds 12, but is the exact product of two figures in the multiplication table, divide first by one of those figures, and that product by the other.

Examples.

		$	*cts.*	*m.*				$	*cts.*	*m.*
19.	Divide	45	66	5	by	36	*Ans.*	1	26	8+17.
20.	—	98	77	8	by	44	—	2	24	4+42.
21.	—	77	87	5	by	96	—	0	81	1+19.
22.	—	288	$68\frac{3}{4}$		by	108	—	2	$67\frac{1}{4}$	+13.
23.	—	496	$37\frac{1}{2}$		by	132	—	3	76	0+55.

£ *s.* *d.* £ *s.* *d.*
24. Divide 87 19 4½ by 32 *Ans.* 2 14 11¾+2.
25. — 55 4 7¾ by 21 — 2 12 7+19.
26. — 97 15 6¼ by 56 — 1 14 11+9.
Hhd. *gal.* *qt.* *Hhd.* *gal.* *qt.*
27. Divide 44 28 2 by 63 *Ans.* 0 44 1+51.
28. — 150 47 3 by 120 — 1 16 0+71.

If the divisor exceeds 12, and is not the product of any two figures in the multiplication table, or exceeds the product of any two figures multiplied together, the operation must be performed by Long Division.

Examples.

$ *cts.* *m.*
29. Divide 47 68 7 by 45.
45)47 68 7(1.06.9 *Ans.*
45
268
225
437
405
32 remainder

£ *s.* *d.*
30. Divide 77 12 6½ by 58.
58)77 12 6½(1 6 9 *Ans.*
58
19
20
392
348
44
12
534
522
12
4
50 remainder.

$ *cts.* $ *cts.* *m.*
31. Divide 196 75 by 78 *Ans.* 2 52 2+34.
32. — 496 87½ by 97 — 5 12 2+41.
33. — 376 81¼ by 123 — 3 06 3+63.

		£	*s.*	*d.*				£	*s.*	*d.*
34.	Divide	44	7	6	by	87	*Ans.*	0	10	2¼+57.
35.	—	156	15	8¾	by	148	—	1	1	2+147.

Practical Examples.

1. If 24 yards of cloth cost $47 87*cts.* 5*m.*, what is the price of 1 yard? *Ans*: $1 99*cts.* 4*m.*+19.

2. If 112 gallons of oil cost $64 81¼*cts.*, what is the price per gallon? *Ans.* 57¾*cts.*+53.

3. When 72 bushels of corn cost $56 25*cts.*, what is the price per bushel? *Ans.* 78*cts.* 1*m.*+18.

4 Sold a hogshead of brandy, containing 63 gallons, for $125: what is the price of a single gallon at that rate? *Ans.* $1 98*cts.* 4*m.*+8.

5. What is the price of 1*cwt.* of sugar, if 4*cwt.* cost £18 17*s.* 6*d.*? £4 14*s.* 4½*d.*

6. Supposing $1875 81¼*cts.* to be equally divided among 125 men, what will be the share of each man? *Ans.* $15 00½*ct.*+75.

7. If 1000 gallons of wine, cost £567 18*s.* 9½*d.*, what is that for 1 gallon? *Ans.* 11*s.* 4¼*d.*+222.

8. Eighty-nine men agree to divide amongst them 150*gal.* 2*qt.* 1*pt.* of brandy: what is the share of each man? *Ans.* 1*gal.* 2*qt.* 1*pt.*+48.

9. If a hogshead of sugar, containing 9*cwt.* 1*qr.* 25*lb.*, be divided equally among 19 persons, how much ought each person to receive? *Ans.* 1*qr.* 27*lb.*+16.

◆

REDUCTION.

Reduction is a rule by which quantities are brought from one denomination to another, but without affecting the value of the quantities so reduced.

There are two kinds of Reduction: that by which higher denominations are brought to lower denominations, or descending reduction; and that by which low denominations are brought to higher denominations, or ascending reduction.

Rule.

When high denominations are to be brought to lower denominations, as for example, dollars to cents, or pounds to shillings, *multiply* by as many of the next lower denomination as make one of the higher.

When low denominations are to be brought to higher denominations, as for example, cents to dollars, or shillings to pounds, *divide* by as many of the lower as make one of the higher

Proof.—Descending and Ascending Reduction mutually prove each other.

Questions.

For what purpose is Reduction used?

How many kinds of Reduction are there, and how are they distinguished?

When high denominations are to be brought to lower denominations, how do you proceed?

When low denominations are to be brought to higher denominations, how do you proceed?

How is Reduction proved?

REDUCTION OF FEDERAL MONEY.

To reduce dollars to cents, multiply the dollars by the number of cents which make a dollar.

Examples.

1. Reduce 10 dollars to cents.	*Ans.* 1000*cts.*
2. Reduce 25 dollars to cents.	*Ans.* 2500*cts.*
3. Reduce 387 dollars to cents.	*Ans.* 38700*cts.*

To reduce cents to fourths, halves, or thirds, multiply them by the number of quarters, halves, or thirds, which make a cent.

4. Reduce 25 cents to fourths.	*Ans.* 100 fourths.
5. Reduce 50 cents to half cents.	*Ans.* 100 halves.
6. Reduce 150 cents to thirds of cents.	*Ans.* 450 thirds.

To reduce dollars to halves, quarters, or thirds of a cent, bring them first into cents, and then bring the cents into halves, quarters, or thirds, as required.

7. Bring 50 dollars to half cents. *Ans.* 10000 halves.
8. Reduce 25 dollars to thirds of a cent. *Ans.* 7500 thirds.
9. Reduce 275 dollars to fourths of a cent. *Ans.* 110000 fourths

To reduce dollars to dimes, multiply the dollars by 10, the number of dimes which make a dollar.

To reduce the dimes to mills, multiply the dimes by 100, the number of mills in a dime.

10. Reduce 10 dollars to dimes. *Ans.* 100*dimes.*
11. Reduce 220 dollars to mills. *Ans.* 220000*mills.*

Note.—When more than one denomination is given to be reduced, the highest denomination must be multiplied by as many as make one of the next lowest denomination, and the lower denominations must be added in.

1. Reduce 15 dols. 15 cents, to cents. *Ans.* 1515*cts.*
2. Reduce 2 dols. 25 cents to fourths. *Ans.* 900 fourths.
3. Reduce 17 dols. 18¾ cents to fourths. *Ans.* 6875 fourths.
4. Bring 13 dols. 27⅓ cents to thirds. *Ans.* 3982 thirds.
5. Reduce 426 dollars 88½ cents to half cents. *Ans.* 85377 halves.

ENGLISH MONEY.

To reduce pounds to shillings, multiply the pounds by 20, the number of shillings which make a pound.

1 Reduce £27 to shillings.

$$\begin{array}{r} 27 \\ 20 \\ \hline \end{array}$$

Ans. 540 shillings.

2. Reduce 364 pounds to shillings. *Ans.* 7280*s.*

To reduce shillings to pence, multiply them by 12, the number of pence which make a shilling.

3. Bring 20 shillings to pence. *Ans.* 240*d.*
4. Reduce 70 shillings to pence. *Ans.* 840*d.*

To reduce pence to farthings, multiply the pence by 4, the number of farthings which make a penny.

5. Reduce 12 pence to farthings. *Ans.* 48 farthings.
6. Bring 26 pence to farthings. *Ans.* 104 farthings.
7. Reduce £12 10*s.* to shillings.

20

Ans. 250*s.*

8. Reduce £18 12*s.* 7*d.* to pence. *Ans.* 4471.
9. Reduce £105 13*s.* 9½*d.* to farthings. *Ans.* 101462.
10. Bring £36 19*s.* 7¾*d.* to farthings. *Ans.* 35503.

To reduce cents into pence Pennsylvania currency, multiply the cents by 9, and divide that product by 10.

1. Reduce 4560 cents into pence.

9

---

10)41040

4104 pence.

2. 36975 cents into pence. *Ans.* 33277½*pence.*
3. 57697 cents into pence. *Ans.* 51927¼+*pence.*

To reduce pence into cents Pennsylvania currency, multiply the pence by 10, and divide that product by 9.

1. Reduce 7290 pence into cents.

7290
10

---

9)72900

8100 cents.

2: Reduce 4590 pence to cents. *Ans.* 5100*cts.*

3. Reduce 76975 pence to cents. *Ans.* 85527*cts.* 7*m* +7

AVOIRDUPOIS WEIGHT.

1. Bring 13 tons to *cwt.*
20
———
Ans. 260*cwt.*

2. Reduce 260*cwt.* to quarters. *Ans.* 1040*qr.*
3. Reduce 36*qr.* to pounds. *Ans.* 1008*lb.*
4. Bring 17*lb.* to ounces. *Ans.* 272*oz.*
5. Bring 20 ounces to drams. *Ans.* 320*dr.*
6. Bring 5*T.* 12*cwt.* 2*qr.* to quarters. *Ans.* 450*qr.*
7. Bring 2*qr.* 25*lb.* 10*oz.* to drams. *Ans.* 20896*dr.*

APOTHECARIES' WEIGHT.

1. Reduce 28 pounds to ounces.
12
———
Ans. 336*oz.*

2. Bring 72 ounces to drams. *Ans.* 576ʒ.
3. In 10 pounds how many grains? *Ans.* 57600*gr.*
4. Reduce 15℔ 9℥ 4ʒ 2℈ 17*gr* to grains. *Ans.* 91017*gr.*

CLOTH MEASURE.

1. Reduce 24 quarters to nails.
4
———
Ans. 96*na.*

2. Bring 36 yards to quarters. *Ans.* 144*qr.*
3. Bring 20 ells English to quarters. *Ans.* 100*qr.*
4. In 16 ells Flemish how many nails? *Ans.* 192*na.*
5. Bring 5 ells Flemish 2 quarters to quarters. *Ans.* 17*qr.*
6. Bring 37 ells French 2 quarters to quarters. *Ans.* 187*qr.*
7. In 19*yds.* 2*qr.* 1*na.* how many nails? *Ans.* 313.

DRY MEASURE.

1. Reduce 13 quarts to pints.
2

Ans. 26*pts.*

2. Bring 32 pecks to quarts. *Ans.* 256*qt.*
3. Reduce 7 bushels to pecks. *Ans.* 28*pe.*
4. Bring 12 bushels to pints. *Ans.* 768*pt.*
5. Bring 14*bu.* 3*qt.* to quarts. *Ans.* 451*qt.*
6. In 24*bu.* 1*pe.* 2*qt.* 1*pt.* how many pints? *Ans.* 1557*pt.*

LAND MEASURE.

1. Bring 3 roods to perches.
40

Ans. 120*P.*

2. Reduce 132 acres to perches. *Ans.* 21120*P.*
3. Reduce 54*A.* 3*R.* 23*P.* to perches. *Ans.* 8783*P.*

SQUARE MEASURE.

1. Bring 4 square feet to square inches.
144

Ans. 576*sq. in.*

2. 120 square yards to square inches. *Ans.* 155520.
3. Bring 29*sq. yd.* 2*sq. ft.* 102*sq. in.* to square inches. *Ans.* 37974*sq. in.*

LIQUID MEASURE.

1 Reduce 17 quarts to pints.
2

Ans. 34*pt.*

2 Bring 28 gallons to quarts. *Ans.* 112*qt.*
3. Reduce 5 hogsheads to gallons. *Ans.* 315*gal.*
4. Bring 110 gallons to pints. *Ans.* 880*pt.*

5. In 6 tuns how many pints? *Ans.* 12096*pt.*
6. Bring 7*hhd.* 41*gal.* 2*qt.* to quarts. *Ans.* 1930*qt.*
7. Bring 47*gal.* 2*qt.* to pints. *Ans.* 380*pt.*
8. Reduce 4*hhd.* 3*qt.* to pints. *Ans.* 2022*pt.*
9. Reduce 19*T.* 27*gal.* to quarts. *Ans.* 19260*qt.*
10. Bring 5*T.* 1*hhd.* 15*gal.* 1*qt.* 1*pt.* to pints. *Ans.* 10707*pt.*

LONG MEASURE.

1. Reduce 27 feet to inches.
12

Ans. 324*in.*

2. Bring 48 yards to feet. *Ans.* 144*ft.*
3. Reduce 27 poles to yards. *Ans.* 148½*yd.*
4. Bring 18 furlongs to poles. *Ans.* 720*po.*
5. Reduce 34 miles to furlongs. *Ans.* 272*fur.*
6. Reduce 108 leagues to miles. *Ans.* 324*M.*
7. Bring 17 miles to poles. *Ans.* 5440*po.*
8. Bring 20 miles to yards. *Ans.* 35200*yd.*
9. In 6 leagues, how many inches? *Ans.* 1140480*in.*
10. Reduce 14 feet 9 inches to inches. *Ans.* 177*in.*
11. Bring 37 yards 1 foot to feet. *Ans.* 102*ft.*
12. Bring 112*fur.* 29*po.* to yards. *Ans.* 24799½*yd.*
13. Reduce 450*M.* 6*fur.* 32*po.* to poles. *Ans.* 144272*po.*
14. In 2*L.* 1*M.* 3*fur.* 16*po.* 3*yd.* 2*ft* 10*in.* how many inches? *Ans.* 470590*in*

TROY WEIGHT.

1. Bring 78 pennyweights to grains.
24

312
156

Ans. 1872*gr.*

2. Reduce 116 ounces to pennyweights. *Ans.* 2320*dwt.*

3. In 25 pounds, how many grains? *Ans.* 144000*gr.*
4. Bring 29*oz.* 16*dwt.* to pennyweights. *Ans.* 596*dwt.*
5. How many grains are there in 19*lb.* 11*oz.* 14*dwt.* 21*gr.*? *Ans.* 115077*gr.*

TIME.

1. Bring 30 minutes to seconds. *Ans.* 1800*sec.*
2. Reduce 12 hours to minutes. *Ans.* 720*min.*
3. Reduce 12 years to months. *Ans.* 144*mo.*
4. Reduce 3*d.* 5*h.* 29*min.* to minutes. *Ans.* 4649*min.*

MOTION, OR CIRCLE MEASURE.

1. Reduce 24 degrees to minutes. *Ans.* 1440′.
2. In 4 signs how many seconds? *Ans.* 432000″.
3. Reduce 11*sig.* 12° to degrees. *Ans.* 342°.
4. How many seconds are there in 4*sig.* 3° 18′ 27″? *Ans.* 443907″.

Promiscuous Examples.

1. In 35 dollars how many cents? *Ans.* 3500
2. How many miles are there in 98 furlongs? *Ans.* 12*M.* 2*fur.*
3. How many weeks are there in 365 days? *Ans.* 52*we.* 1*da.*
4. In 84 half cents how many cents? *Ans.* 42*cts.*
5. In 8*T.* 15*cwt.* how many hundred weight? *Ans.* 175*cwt.*
6. How many perches are there in 63 roods? *Ans.* 2520*square per.*
7. How many pounds in 157*s.*? *Ans.* £7 17*s.*
8. In 175 pecks how many bushels? *Ans.* 43*bu.* 3*pe.*
9. In 7642 cents how many dollars? *Ans.* $76 42*cts.*
10. In 103 pints how many quarts? *Ans.* 51*qt.* 1*pt.*
11. How many minutes are there in 720 seconds? *Ans.* 12*min.*
12. In 7 hogsheads 33 gallons how many gallons? *Ans.* 474*gal.*

13. How many ells English are there in 100 quarters of a yard? *Ans.* 20*E. E.*

14. In 108*dwt.* how many ounces? *Ans.* 5*oz.* 8*dwt.*

15. How many pounds are there in 250*s.*? *Ans.* £12 10*s.*

16. How many scruples are there in 7 drams? *Ans.* 21 ℈.

17. How many pence are there in 8*s.* 8*d.*? *Ans.* 104*d.*

18. In 203 days how many weeks? *Ans.* 29*we.*

19. How many nails are there in 16 quarters of a yard? *Ans.* 64*na.*

20. In 74 drams how many ounces avoirdupois? *Ans.* 4*oz.* 10*dr.*

21. How many three-pences are there in 13*s.*? *Ans.* 52 three-pences

22. How many *cwt.* in 20 tons? *Ans.* 400*cwt*

23. How many ells French are in 81 quarters? *Ans.* 16*E. Fr.* 1*qr*

24. In 21*gal.* 3*qt.* 1*pt.* how many pints? *Ans.* 175*pt*

25. How many furlongs are there in 3*M.* 1*fur.*? *Ans.* 25*fur.*

26. How many dollars are there in 1235 cents? *Ans.* $12 35*cts.*

27. How many minutes are there in 3 days? *Ans.* 4320*min.*

28. In 121 cents how many quarters of a cent? *Ans.* 484 quarters.

29. In 13 pounds avoirdupois how many drams? *Ans.* 3328*dr.*

30. How many ells Flemish are there in 154 quarters? *Ans.* 51*E. Fl.* 1*qr.*

31. How many pounds are there in 2461*dwt.*? *Ans.* 10*lb.* 3*oz.* 1*dwt.*

32. In 12*yd.* 2*qr.* 1*na.* how many nails? *Ans.* 201*na.*

33. In 584621 gallons how many tuns? *Ans.* 2319*T.* 3*hhd.* 44*gal.*

34. How many drams are there in 725*lb.* 6*oz.* avoirdupois? *Ans.* 185696*dr.*

35. How many *cwt.* are there in 27552*lb.*? *Ans.* 246*cwt.*

36. How many farthings are there in £5 4*s.* 6¼*d.*
Ans. 5017 farthings.

37. In 763 days how many weeks? *Ans.* 109*we.*

38. How many pence are there in £85 10*s.* 7*d.*?
Ans. 20527*d.*

39. In 1220 grains how many drams? *Ans.* 20ʒ 1℈.

40. How many ells English are there in 27*qr.*?
Ans. 5*E. E.* 2*qr.*

41. How many bushels are there in 1357 pints?
Ans. 21*bu.* 0*pe.* 6*qt.* 1*pt.*

42. How many acres are there in 8654 perches?
Ans. 54*A.* 0*R.* 14*P.*

PROPORTION, OR THE SINGLE RULE OF THREE.

By the rule of Proportion or Rule of Three, we ascertain the proportion which numbers bear to each other.

It is called the Rule of Three, because there are three terms given to find a fourth?

1. *Rule for Stating.*

1. Place that term in the third place which is of the same name or kind with that in which the answer is required.

2. Consider whether the answer ought to be greater or less than the third term.

3. If the answer ought to be greater than the third term, set the greater of the two remaining numbers on the left for the second term; and the remaining number to the left of the second for the first term.

4. But if the answer ought to be less than the third term, set the less of the two remaining numbers in the second place; and the greater in the first place.

Having thus prepared the question, you may proceed to perform the operation by the following

Rule.

1. Reduce the third term to the lowest denomination mentioned in it.

2. Reduce the first and second terms to the same denomination, and to the lowest denomination mentioned in either of them.

3. Multiply the second and third terms together, and divide the product by the first term; the result will be the fourth term, or answer, in the same denomination to which the third term was reduced.

4. Reduce the fourth term, or answer, to that denomination in which the answer is required.

Note.—By this rule, no distinction is necessary between direct and inverse proportion.

The foregoing rule for stating is very much to be preferred to that which has formerly been in general use, and is likely soon to be universally adopted. But as there may be some who give a preference to the former mode of stating, the following is given that it may be used by those who prefer it.

2. *Rule.*

1. Set that term in the first place which is of the same name with the term of demand; and that term in the second place which is of the same name with that in which the answer is required; and the term of demand in the third place.

2. Consider, from the nature of the question, whether the proportion is direct or inverse.

The proportion is direct when the third term is greater than the first, and the nature of the question requires that the fourth term should be greater than the second.

The proportion is inverse, when the third term is more than the first, but the nature of the question requires that the fourth term should be less than the second.

3. Reduce the first and third terms to the same denomination, and to the lowest denomination mentioned in either, and the second term to the lowest denomination mentioned in it.

4. If the proportion be direct, multiply the second and

third terms together; but if inverse, multiply the first an second terms together, and divide by the remaining term and the product will be the fourth term, or answer, in the same denomination with that to which the second term was reduced, which must be brought to that denomination in which the answer is required.

Proof.—By reversing the statement.

Questions.

What are we able to ascertain by Proportion, or th Rule of Three; and why is it called by that name?

Which of the terms must be placed in the third place

After having set down the third term, what have yo next to consider?

How do you proceed, if the answer ought to be greate than the third term?

How do you proceed, if the answer ought to be le than the third term?

After having prepared the question, what must you d with the third term?

To what must you reduce the first and second terms?

Which of the terms must you multiply together, an by which must you then divide?

After having divided by the first term, in what denomination will your answer be?

What must be done to complete the operation?

How do you prove the Rule of Three?

Examples.

1. If 6*lbs.* of cheese cost 55 cents, what will 75*lbs.* come to at that rate?

lbs. *lbs.* *cts.*	*lbs.* *cts.* *lbs.*
By 1st rule 6 : 75 : : 55	By 2d rule 6 : 55 : : 75
75	55
375	275
375	385
6)4125	6)4125
Ans. $6.87½	*Ans.* $6.87½

2. If eight men can reap a field of grain in four days, how many days will it require for sixteen men to do it?

	men.	*da.*	*men.*			*men.*	*men.*	*da.*
Inverse	8 :	4 : :	16		1st Rule	16 :	8 : :	4
		4						8
		16)32(2						16)32(2
		32						32

3. If 2 pounds of butter cost 50 cents, what will 8 pounds cost? *Ans.* $2 00*cts.*

4. If 1 pound of sugar cost 12 cents, what must I pay for 5 pounds? *Ans.* 60*cts.*

5. Sold 10 yards of linen for 5 dollars 50 cents: what was it per yard? *Ans.* 55*cts.*

6. If 7 pounds of cheese cost 87½ cents, what must I pay for 122 pounds? *Ans.* $15 25*cts.*

7. If 1 bushel of salt cost 72 cents, what will 209 bushels cost? *Ans.* $150 48*cts.*

8. When 5 pounds of soap cost 55 cents, what is it per pound? *Ans.* 11*cts.*

9. If 1 yard of cloth cost 4 dollars 25 cents, what will 18 yards come to? *Ans.* $76 50*cts.*

10. Sold 76 pounds of coffee for 24 dollars 32 cents: what was it per pound? *Ans.* 32*cts.*

11. If 8 bushels of potatoes cost 3 dollars 94 cents, what were they per bushel? *Ans.* 49*cts.* 2*m.*+4.

12. If 1 pound of beef cost 7½ cents, what will 57 pounds cost? *Ans.* $4 27½*cts.*

13. How much will 243 bushels of corn come to, at 45 cents per bushel? *Ans.* $109 35*cts.*

14. If tea be sold at 1 dollar 12½ cents per pound, what will 147 pounds come to? *Ans.* $165 37½*cts.*

15. What cost 869 pounds of rice, at 4½ cents per pound? *Ans.* $39 10½*cts.*

16. If 24 yards of cloth cost 125 dollars 24 cents, what is it per yard? *Ans.* $5 21*cts.*+20.

17. If 1 cwt. of candles cost 11 dollars 50 cents, what are they per pound? *Ans.* 10*cts.* 2*m.*+76.

18. What will 218 pounds of pork amount to at 7 cents per pound? *Ans.* $15 26*cts.*

19. What is wheat per bushel, when 57 bushels cost £30 10. *Ans.* 10*s.* 8¼*d.*+39.

20. If 1 ounce of silver cost 72 cents, what will 3 pounds 5 ounces amount to? *Ans.* $29 52*cts.*

21. When 1 pound of cinnamon costs 10 cents, what will be the price of 135 pounds? *Ans.* $13 50*cts.*

22. If 2 cwt. of cheese cost £7 12*s.* 6*d.*, what must be paid for 15 tons 3 cwt.? *Ans.* £1155 3*s.* 9*d.*

23. Sold a quantity of brandy for £54 7*s.* 6*d.*, at 4*s.* 10*d.* per gallon: how many gallons were there? *Ans.* 225*gal.*

24. What is the amount of board for one year, at 2 dollars and 50 cents per week? *Ans.* $130.

25. Sold a piece of land containing 34 acres 1 rood 17 perches, at 42 dollars 25 cents per acre: what am I to receive? *Ans.* $1451 55*cts.*+25.

26. If a pipe of wine, containing 131 gallons, cost £65 10*s.* what was it per gallon? *Ans.* 10*s.*

27. If 754 dollars pay for 1 tun of brandy, how much can I buy for 1754 dols.? *Ans.* 2*T.* 1*hhd.* 19*gal.* 0*qt.* 1*pt.*

28. If 7 yards of muslin cost 18*s.* 8*d.*, what number of yds. can I buy for £36 16*s.* at the same rate? *Ans.* 276*yd.*

29. If 1 pound of sugar cost 9½ cents, what will be the price of a hogshead weighing 5 cwt. 2 qrs. and 17 lbs.? *Ans.* $60 13*cts.* 5*m.*

30. When 114 cents is the price of a pound of tea, how much can I buy for 354 dols.? *Ans.* 310*lb.* 8*oz.* 6*dr.*+84.

31. If 100 skeins of silk cost £2 10*s.*, how many skeins can be bought for £105 3*s.*? *Ans.* 4206 skeins.

32. If a piece of cloth, containing 39 yards, cost 350 dollars 22 cents, what is it per yard? *Ans.* $8 98*cts.* 4*m.*

33. If 1 pint of brandy cost 37½ cents, what will be the price of 2 hogsheads, one containing 61½ gallons, and the other 62 gallons 1 quart and 1 pint? *Ans.* $371 62½*cts.*

34. A man sold two loads of corn, one containing 75 bushels and the other 87 bushels, at 52 cents per bushel; what will he receive? *Ans.* $84 24*cts.*

35. If a person spend daily 1 dollar 87½ cents, and his annual income be 1022 dollars, what sum may he save at the year's end? *Ans.* $337 62½*cts.*

36. Bought a stove, weighing 4 cwt. 3 qrs. 24 lbs., at 2 dollars 10 cents per cwt., and 27 lbs. of pipe at $18\frac{3}{4}$ cents per pound, with two elbows at 50 cents each: what is the price of the stove, pipe, and elbows? *Ans.* $16 $48\frac{3}{4}$*cts.*

37. A man covered 14 pair of window-shutters with tin, each shutter requiring $8\frac{1}{2}$ sheets, for which he was to have $11\frac{1}{2}$ cents per sheet: what will he receive when they are finished? *Ans.* $27 37*cts.*

38. A ship's crew, consisting of 45 men, are provided with 4500 lbs. of bread, of which each man eats 1 lb. per day: how many weeks will it last them? *Ans.* 14*w.* 2*d.*

39. If 12 acres 2 roods produce 443 bushels and 3 pecks of corn, what quantity will 37 acres 3 roods 5 perches produce? *Ans.* 1341*bu.* 0*p.* 7*qt.* 1*pt.*

40. A merchant bought 27 cwt. 2 qrs. of sugar, for 204 dollars; paid for carriage 15 dollars 75 cents; storage 18 dollars $31\frac{1}{4}$ cents: what must he sell it for per hundred, to gain 57 dollars on the whole? *Ans.* $10 72*cts.* 9*m.*+60.

41. A bankrupt owes in all 18,284 dollars 40 cents, and delivers up his whole property, amounting to 9,142 dollars 20 cents: how much per cent. can he pay, and what does that creditor receive to whom he owed 472 dollars?
Ans. 50 per cent.; $236.

INVERSE PROPORTION.

Note.—In all cases wherein labour is required to be performed, the day must be reckoned at 12 hours.

42. If six men can do a piece of work in 18 days, how long will it require 12 men to do it? *Ans.* 9*days.*

43. Suppose 20 days be required for 12 men to build a house, in what time can 18 men do the same? *Ans.* 13*d.* 4*h.*

44. If eight men can mow a piece of meadow in 24 days, how many men can do it in 4 days? *Ans.* 48*men.*

45. In what time will 48 men make a fence, which 12 men can do in 24 days? *Ans.* 6*days.*

46. If a traveller performs a journey in 5 days, when the days are 11 hours long, how long will he require to do it when they are 15 hours long? *Ans.* 3*days* 10*h.*

47. How many yards of carpeting, 2 feet 3 inches broad,

will it require to cover a floor that is 48 feet long and 30 feet 6 inches broad? *Ans.* 216*yd.* 2*ft.* 8*in.*

48. How many men will it require to repair a piece of work in 50 days, when 14 men can do it in 100 days? *Ans.* 28*men.*

Promiscuous Examples.

49. If 1 cwt. of sugar cost 11 dollars 37½ cents, what will 18 cwt. 3 qrs. 19 lbs. cost? *Ans.* $215 21*cts.*+10½.

50. Bought 156 yards of cloth for 730 dollars, a part of which being damaged, I am willing to lose 22 dollars on the whole: at what rate then must I sell it per yard? *Ans.* 4 53*cts.* 8*m.*+72.

51. Bought 19 cwt. 2 qrs. 17 lbs. of tobacco at 9 dollars 31¼ cents, per cwt., and sold it for 10 dollars 65 cents per cwt.: what was the prime cost; what was it sold for; what was the gain?

Ans. { Cost $183 00*cts.* 7*m.*
Sold for $209 29*cts.* 1*m.*+
Gain $ 26 28*cts.* 4*m.*

52. If 47 yards of muslin cost 14 dollars 75 cents, what was it per yard? *Ans.* 31*cts.* 3*m.*+

53. A number, consisting of 354 men, are to be clothed, each suit to contain 3¾ yards of cloth that is 1¼ yards wide, and to be lined with holland which is three quarters of a yard wide; how many yards of holland will line them? *Ans.* 2212½*yd.*

54. A pole whose height is known to be 25 feet, at o'clock at noon casts a shadow on level ground to the distance of 33 feet 10 inches. What is the breadth of river which runs east and west close by the north side the bottom of a tower known to be 250 feet high, if the shadow of the tower projects 18 feet 6 inches beyond the opposite bank of the river? *Ans.* 319*ft.* 10*in.*

55. The earth which we inhabit is three hundred sixty degrees in circumference, and turns round on its once in twenty-four hours; a degree of longitude at the equator is 69½ miles, but a degree of longitude in the latitude of 40 degrees is only 46 miles: how many miles the inhabitants at the equator carried in one minute this motion, and how much farther in a minute are

carried by it than the inhabitants who live in latitude 40 degrees?

Ans. The inhabitants of the equator are carried 17*M.* 3*fur.*, and 5*M.* 7*fur.* farther than in lat. 40°.

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DOUBLE RULE OF THREE.

The Double Rule of Three is that in which five terms are given to find the sixth; three of the given terms being a supposition, and two a demand.

Rule.

1. Set that term which is of the same name with that in which the answer is required in the third place.
2. Consider each pair of similar terms separately, and the third one, as the terms of a statement in the single rule of three, and set them in the first or second places, as directed in the rule for stating the single rule of three.
3. Multiply the two terms in the first place together.
4. Multiply the two terms in the second place together.
5. Multiply the product of the two terms of the second place by the term standing in the third place, and divide that product by the product of the two terms standing in the first place, for the answer in the same denomination with that of the third place.

Note.—If the terms consist of different denominations, they must be reduced as in the single rule.

Proof.—By two statements in the single rule of three, or by inverting the statement.

Questions.

What is the Double Rule of Three?

When you are about to make a statement in the Double Rule of Three, which of the terms is first to be set down, and in what place?

What is then to be considered?

What is to be done with the two terms which stand in the first place?

What is to be done with the two terms which stand in the second place?

By what do you multiply the product of the two terms standing in the second place; and by what do you divide that product for the answer?

What is to be noted when the terms consist of different denominations?

How do you prove the Double Rule of Three?

Examples.

1. If 10 men in 18 days earn 56 dollars, how many dollars can 20 men earn in 35 days?

men 10 20 } 56 dols.
days 18 35 }
180 100
60
700
56
4200
3500
180)39200($217 77*cts.* 7*m.*+ *Ans.*
360
320
180
1400
1260
1400
1260
1400
1260
1400
1260
140 Rem.

2. If 3 men in 12 days can reap 32 acres, how many acres can 8 men reap in 24 days? *Ans.* 170*A.* 2*R.* 26*P*, 20*yd.*+

3. When 10 oxen in 18 days eat two acres of grass, how many acres will serve 20 oxen 27 days? *Ans.* 6*A.*

4. If 36 pounds of bread be sufficient for 9 men 10 days, how many pounds will suffice 24 men 5 days? *Ans.* 48*lb.*

5. If 100 dollars in a year give 6 dollars interest, what will 335 dollars give in 18 months? *Ans.* $30 15*cts.*

6. If 56 dollars 31¼ cents be the wages of 20 men for 5 days, what will 46 men earn in 32 days? *Ans.* $828 92*cts.*

7. Suppose 8 men can make 120 pair of shoes in 30 days, how many can 12 men make in 90 days? *Ans.* 540*pair.*

8. If 37*lb.* of beef be sufficient for 12 persons 4 days, how many *lb.* will suffice 38 men 16 days? *Ans.* 468*lb.* 10⅔*oz.*

9. If 2 quarts and 1 pint of oil be sufficient for 8 lights 4 evenings, what quantity will supply 12 lights 7 evenings? *Ans.* 13*pt.*+32.

10. If 7½ yards of cloth that is 3 quarters wide cost 17 dols. 37½ cts., what will be the price of 24 yds. and 2 qrs. which is 7 qrs. wide? *Ans.* $132 43*cts.*+55.

11. If 12 bushels of oats be sufficient for 20 horses 22 days, how many bushels will serve 62 horses 36 days? *Ans.* 60*bu.* 3*pe.* 3*qt.* 1*pt.*+376.

12. What is the interest of 563 dollars for 4 years and a half, at 6 per cent. per annum? *Ans.* $152 01*ct.*

13. If 6 tons of hay be sufficient for 8 horses 7 months, how much will serve 20 horses 1 year and 5 months? *Ans.* 36*T.* 8*cwt.* 2*qr.* 8*lb.*

14. When 1 pound of thread makes 2 yards of linen 5 quarters wide, how many pounds of thread would be wanted to make a piece of linen 50 yards long and 3 quarters of a yard wide? *Ans.* 15*lb.*

15. If 7 reapers have 21 dollars for 3 days' work, how many will earn 96 dollars in 32 days? *Ans.* 3 *reapers.*

16. If 100 dollars in 1 year gain 7½ dollars interest, what sum will gain 9 dollars in 4 months? *Ans.* $360.

17. If 27 men can build a wall 40 feet high and 54 feet long in 10 days, in how many days can 72 men build a wall 20 feet high of the same length? *Ans.* 1*da.* 10½*h.*

18. If a man can travel 305 miles in 30 days, when the days are 14 hours long, in how many days can he travel 1056 miles, when the days are 12½ hours long?

Ans. 116*days.*+2540.

19. If 210 dollars will defray the expenses of 4 men for 24 weeks and 3 days, how long will 15 men be in spending 837 dollars? *Ans.* 25*we.* 6*da.*+2358.

20. If 50 dollars in 5 years gain 15 dollars, what sum will gain 30 dollars in 2 years and a half? *Ans.* $200.

21. If 5 men receive 20 dols. 50 cts. for 4 days' labour, how much must 34 men get for 90 days? *Ans.* $3136 50cts.

22. If the carriage of 24 cwt. for 45 miles be 18 dollars, how much will it cost to convey 76cwt. 121 miles?

Ans. $153 26*cts.*+720.

23. If 6 men in 7 days can mow 42 acres of grass, how many men can mow 392 acres in 14 days? *Ans.* 28 *men.*

24. If 35 cwt. be carried 20 miles for 9 dollars and 50 cents, how much will 50 cwt. cost to be carried 150 miles? *Ans.* $101 78½*cts.*+2.

25. If 125 dollars in 1 year and 6 months gain 11 dollars and 75 cents, what sum will gain 31 dollars 18¾ cents in 9 months? *Ans.* $663 56¼*cts.*+2250.

26. What is the interest of 275 dollars for 4 years and 8 months, at 6 per cent. per annum? *Ans.* $77.

27. With how many dollars could I gain 6 dollars in 1 year, if with 560 dollars I gain 56 dollars in 1 year and 8 months? *Ans.* $100.

28. If 5 pounds of worsted make 12 yards of stuff, of 1 yard 1 quarter broad, how many pounds would be wanted to make 75 yards, 3 quarters of a yard wide?

Ans. 52*lb.*+3.

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PRACTICE.

Practice is a short method of working such questions in the single rule of three as have one for their first term.

Practice Table, or Table of Aliquot Parts.

cts.		$	
50	=	$\frac{1}{2}$	of a dollar.
25		$\frac{1}{4}$	
20		$\frac{1}{5}$	
$12\frac{1}{2}$		$\frac{1}{8}$	
$6\frac{1}{4}$		$\frac{1}{16}$	
5		$\frac{1}{20}$	
4		$\frac{1}{25}$	
m.		*cts.*	
5	=	$\frac{1}{2}$	of a ct.
2		$\frac{1}{5}$	
1		$\frac{1}{10}$	

s.	*d.*		£	
10	0	=	$\frac{1}{2}$	of a pound.
6	8		$\frac{1}{3}$	
5	0		$\frac{1}{4}$	
4	0		$\frac{1}{5}$	
3	4		$\frac{1}{6}$	
2	6		$\frac{1}{8}$	
1	8		$\frac{1}{12}$	
1	0		$\frac{1}{20}$	
qr.			*d.*	
2			$\frac{1}{2}$	of a d.
1			$\frac{1}{4}$	

qr.	*lb.*		*cwt.*	
2 or	56	=	$\frac{1}{2}$	of a cwt.
1	28		$\frac{1}{4}$	
	16		$\frac{1}{7}$	
	14		$\frac{1}{8}$	
	8		$\frac{1}{14}$	
	7		$\frac{1}{16}$	

Case 1.

When the given price is a ¼, ½, or ¾ of a cent, or any number of mills.

Rule.

Divide the given number by the aliquot, *or* even part of a cent, for the answer in cents.

Note.—If the given price be ¾, take the aliquot part for ½ first, and then for a ¼, and add the products together.

Case 2.

When the given price is cents only.

Rule.

Divide the given quantity by the aliquot parts of a dollar, for the answer in dollars.

Case 3.

When the given price is dollars and cents.

Rule.

Multiply the given quantity by the dollars, and take aliquot parts for the cents, and add the products together for the answer in dollars.

Case 4.

When the quantities given are of various denominations, such as cwt. qrs. and lbs.

Rule.

Set down the given price of one of the highest given denominations, and multiply it by the whole of the highest denomination; then take aliquot parts of the next lowest denomination continually, and add the products together for the answer.

Proof.—By the single rule of three.

Questions.

What is Practice?

Repeat the Practice table, or table of aliquot parts.

When the given price is a ¼, a ½, or ¾ of a cent, or any number of mills, by what rule do you proceed, and what is to be noted if the given price is ¾?

When the given price is cents only, by what rule do you work?

Repeat the rule for performing the operation when the given price is dollars and cents.

By what rule do you work when the given quantity consists of divers denominations, cwt. qrs. and lbs., or the like, and the given price consists of dollars and cents?

How do you prove Practice?

Examples.

CASE 1.

1. What is the value of 48 yards of tape, at a quarter of a cent a yard?

2. What is the value of 1654 yards, at half of a cent a yard?

```
        cts.                      cts.
¼ | ¼ | 48                ½ | ½ | 1654
  |   | ——                  |   | ————
  |   | 12 cents.  Ans.     |   | $8.27   Ans.
```

3. 296 at ¾ each *Ans.* $ 2 22*cts.*
4. 3268 at ½ $16 34*cts.*
5. 4260 at ¾ $31 95*cts.*
6. 5324 at ¼ $13 31*cts.*

7.	634 at 2 mills each.	*Ans.* $ 1	26	8
8.	352 at 4	1	40	8
9.	3456 at 5	17	28	0
10.	498 at 6	2	98	8
11.	8462 at 8	67	69	6
12.	1264 at 7	8	84	8
13.	4628 at 9	41	65	2

Case 2.

1. What is the value of 54260 at 25*cts.* each?

25 | $\frac{1}{4}$ | 54260

135,65*cts.*

2.	What is the value of 3648 at 6¼*cts.*?	$228	00	0
3.	742 at 10	74	20	0
4.	8264 at 20	1652	80	0
5.	386 at 25	96	50	0
6.	5876 at 50	2938	00	0
7.	3542 at 45	1593	90	0
8.	31925 at 80	25540	00	0
9.	4264 at 12½	533	00	0
10.	18626 at 55	10244	30	0
11.	1724 at 37½	646	50	0
12.	528 at 16	84	48	0
13.	13854 at 56¼	7792	87	5
14.	4858 at 29	1408	82	0
15.	2267 at 85	1926	95	0
16.	190 at 20	38	00	0
17.	3654 at 18¾	685	12	5
18.	17638 at 70	12346	60	0

Case 3.

1. What is the value of 5*cwt.* 1*qr.* 14*lb.* at 2 dollars and 50 cents per cwt.?

1*qr* | $\frac{1}{4}$ | $2 50*cts.*

5

14*lb.* | $\frac{1}{2}$ | 12 50

62½

31¼

13 43¾ *Ans.*

2. What is the value of 10cwt. 2 qr. 7 lb. at 10 do
25 cents per cwt.? *Ans.* $108 26

3. What is the value of 7 cwt. 3 qrs. 19 lb. at 4
15 cents per cwt.? *Ans.* $32 86*cts.*

4. What is the value of 129 cwt. 1 qr. 10 lb. at 1 d
5 cents per cwt.? *Ans.* $135 80*cts.* 6*m.*

5. What is the value of 16 cwt. 2 qr. at 5 dolla
cents per cwt.? *Ans.* $85 47*c*

6. What is the value of 130 cwt. 1 qr. at 15 dollars
cwt.? *Ans.* $1953 75*c*

7. What is the value of 25 cwt. 1 qr. 9 lb. at 1 do
75 cents per cwt.? *Ans.* $44 32*cts.* 8*m.*+

8. What is the value of 2 qr. 14 lb. at 27 dolla
cents per cwt.? *Ans.* $16 93¾

9. What is the value of 6 lb. 5 oz. 10 dwt. 5 gr.
dollars 16 cents per lb.? *Ans.* $26 86*cts.*

10. What is the value of 27 lbs. 10 oz. 4 dwt. 1
at 26 dols. 35 cts. per lb.? *Ans.* $733 92*cts.*

11. What is the value of 9 lb. 11 oz. 17 dwt. 22
6 dollars 13 cents per lb.? *Ans.* $61 24*cts.*

12. What is the value of 816 oz. 13 dwt. 12 gr.
cents per ounce? *Ans.* $102 08*cts.*

13. What is the value of 27 yards 3 qr. at 9 dolla
cents per yard? *Ans.* $267 78*cts.*

14. What is the value of 860 yards 1 qr. at 84
per yard? *Ans.* $722 61

15. What is the value of 126 yards 2 qr. 2 nails,
dollars 75 cents per yard? *Ans.* $601 46*cts.* 8*m*

16. What is the value of 428 gals. 3 qts. at 1 doll
cents per gallon? *Ans.* $600 25

17. What is the value of 765 gals. 3 qt. 1 pt. at 2
lars 18¾ cents per gallon? *Ans.* $1675 34

18. What is the value of 5 hhds. 31½ gals. at 47
lars 12 cents per hogshead? *Ans.* $259 16

19. What is the value of 17 hhds. 15 gals. 3 qts.
dols. 75 cents per hogshead? *Ans.* $1116 93*cts.*

20. What is the value of 120 bu. 2 pecks, at 35
per bushel? *Ans.* $42 17*cts.*

21. What is the value of 780 bu. 3 pecks 2 qt
dollar 17 cents per bushel? *Ans.* $913 55*cts.*

22. What is the value of 1354 bu. 1 peck 5 qts. 1 pt. at 25 cents per bushel? *Ans.* $338 60*cts.* 5*m.*+

23. What is the value of 35 acres 2 roods 18 perches, at 54 dollars 35 cents per acre? *Ans.* $1935 53*cts.* 9*m.*

24. What is the value of 146 acres 3 roods 10 perches, at 35 dols. 10 cents per acre? *Ans.* $5153 11*cts.* 8*m.*+

25. What is the value of 750 acres 1 rood 4 perches, at 12 dols. 25 cents per acre? *Ans.* $9190 86*cts.* 8*m.*+

Application.

1. What is the value of 84 cwt. 2 qr. 14 lb. of sugar, at 10 dols. 50 cents per cwt.? *Ans.* $888 56*cts.* 2*m.*+

2. Bought 17 cwt. 1 qr. 7 lb. at 12 dollars 12½ cents per cwt.: what is the amount? *Ans.* $209 91*cts.* 9*m.*

3. Sold 15 T. 10 cwt. 3 qr. of iron, at 80 dols. 15 cents per ton: what is the amount? *Ans.* $1245 33*cts.*+

4. Bought 170 pieces of tape, each piece containing 35 yards 2 qr., at a quarter of a cent per yard: what is the whole price of the tape? *Ans.* $15 08*cts.*+

5. A man bought 175 acres 3 roods 12 perches of land, for which he paid 52 dollars 15 cents per acre: what was the whole? *Ans.* $9169 27*cts.* 2*m.*

6. What is the value of 1365 papers of pins, at a half a cent per paper? *Ans.* $6 82½*cts.*

7. How much will 784 gallons of brandy come to, at 84 cents per gallon? *Ans.* $658 56*cts.*

STERLING MONEY.

Case 1.—When the given price is farthings.

Rule.—Divide by aliquot parts of a penny, for the answer in pence; and reduce the pence to pounds.

Case 2.—When the given price is any number of pence less than twelve.

Rule.—Divide by the aliquot parts of a shilling, for the answer in shillings; which reduce to pounds.

Case 3.—When the given price is pence, but exceeds the number of pence in a shilling.

Rule.—Set down the given quantity as so many shillings, and divide by the aliquot parts of as many pence the given pence exceed twelve; recollecting to add the given quantity: the answer will then be shilli which reduce to pounds.

Case 4.—When the given price is shillings.

Rule.—Divide by the aliquot parts of a pound, for th answer in pounds.

Case 5.—When the given price is pounds, shillings, and pence.

Rule.—Multiply the given quantity by the pounds, an divide by the aliquot parts of the shillings and pence.

Case 6.—When the given quantity consists of dive denominations, and the given price, of one of the highe denominations; as pounds, shillings, and pence.

Rule.—Set down the given price of one of the high denominations, and multiply it by the whole of the hig est denomination, and then divide the given price by t aliquot parts of each of the lower denominations.

Questions.

When the given price is farthings, by what rule do yo work?

When the given price is any number of pence less th twelve, how do you proceed?

How do you proceed when the given price is pence, but exceeds the number of pence in a shilling?

Repeat the rule for performing the operation when th given price is shillings.

By what rule do you work when the given price i pounds, shillings, and pence?

Repeat the rule for performing the operation when th given quantity consists of divers denominations, and th given price is pounds, shillings, and pence.

Examples

CASE 1.

(1) $\frac{1}{4}\big|\frac{1}{4}\big|$ 375 at $\frac{1}{4}$

12)93$\frac{3}{4}$

7*s.* 9$\frac{3}{4}$*d.*

(2) $\frac{1}{2}\big|\frac{1}{2}\big|$ 875 at $\frac{1}{2}$

12)437$\frac{1}{2}$

2|0)3|6 5

£1 16 5$\frac{1}{2}$

(3) $\frac{1}{2}\big|\frac{1}{2}\big|$956 at $\frac{3}{4}$

$\frac{1}{4}\big|\frac{1}{2}\big|$478

239

12)717

2|0)5|9 9

£2 19 9

4. What is the value of 475 at $\frac{1}{4}$? *Ans.* 9*s.* 10$\frac{3}{4}$*d.*
5. 299 at $\frac{1}{2}$ 12*s.* 5$\frac{1}{2}$*d.*
6. 978 at $\frac{3}{4}$ £3 1*s.* 1$\frac{1}{2}$*d.*

CASE 2.

(1) $1\big|\frac{1}{12}\big|$ 487 at 1 penny.

2|0)4|0 7

£2 0 7

		£	*s.*	*d.*
2. What is the value of 978 at	2 pence? *Ans.*	8	3	
3. 499 at	5	10	7	11
4. 792 at	6	19	16	
5. 888 at	9	33	6	
6 921 at	11	42	4	3

CASE 3.

(1) $1\frac{1}{2}\big|\frac{1}{8}\big|$ 896 at 13$\frac{1}{2}$*d.*

112

2|0)100|8

Ans. £50 8

	£	*s.*	*d.*
2. What the value of 487 at 15 pence? *Ans.*	30	8	9
3. 979 at 22$\frac{1}{4}$	90	15	2$\frac{3}{4}$
4. 532 at 23$\frac{3}{4}$	52	12	11$\frac{3}{4}$

CASE 4.

```
(1, 2 | 1/10 | 1096 at 2 shillings.
             ----
             £109 12s.   Ans.
```

			£
2.	What is the value of 489 at 5 shillings?	*Ans.*	122
3.	937 at 11		515 7
4.	1286 at 15		964 1
5.	2798 at 19		2658 2

CASE 5.

```
(1) 10 | 1/2  | 958 at £2 11s. 6d.
       |      |   2
       |      | ----
       |      | 1916
     1 | 1/10 |  479
     6 | 1/2  |   47 18
       |      |   23 19
                ---------
              £2466 17s.   Ans.
```

		£ s. d.		£ s.
2.	What is the value of 569 at	4 13 7½?	*Ans.*	2363 12 7
3.	1967 at	5 16 9¾		11488 10 2
4.	2975 at	7 19 11¾		23796 18 0

CASE 6.

```
    Cwt. qr. lb.   qr.      £   s.  d.
(1)  2   1   4  at  1 | 1/4 | 3   7   6  per cwt.
                      |     |           2
                      |     | ----------
                  lb. |     | 6  15   0
                   4  | 1/7 |    16  10½
                      |     |     2   4¾
                       ----------------
              Ans.        7  14   3¼
```

	Cwt.	qr.	lb.		£	s.	d.		£	s.	d.
2	Cwt.9	2qr.	17lb.	at	£4	7s.	6d.	*Ans.*	£42	4s.	6¼d.
3.	11	1	16	at	5	6	7½		60	14	8¾+
4.	7	3	22	at	1	18	4½		15	5	0¾+
5.	27	1	19	at	2	17	8¼		79	1	8¾

TARE AND TRET.

Tare and **Tret** are allowances made to the buyer, on some particular articles.

Tare is the weight of the box, bag, barrel, or whatever contains the goods sold.

Tret is the allowance made for wastage.

Gross is the weight of the goods sold, with box, bag, or whatever contains them, included.

When the tare is deducted from the gross, what remains is called suttle.

Neat weight is that which remains after all allowances have been deducted.

Case 1.

When the tare is so much on a given quantity gross.

Rule.

Subtract the given tare from the given quantity, and the remainder will be the neat weight.

Case 2.

When the tare is so much per bag, box, hogshead, or other denomination.

Rule.

Multiply the given tare per bag, box, barrel, &c. by the number of bags, boxes, barrels, &c. and subtract the product from the gross; the remainder will be the neat weight.

Case 3.

When the tare is so much on the hundred weight.

Rule.

Divide the gross weight by the aliquot part or parts of a hundred weight, and deduct the amount of the result from the gross, and the remainder will be the neat.

Case 4.

When tare and tret are both allowed.

Rule.

First find the tare, which deduct from the gross, and the remainder will be suttle.

Divide the suttle by 26*, the product will be the tret, which subtract from the suttle, and the remainder will be the neat.

Questions

What are tare and tret?

What is tare?

What is tret?

What is gross?

What is the remainder called, when the tare has been deducted?

What is the remainder called, after all allowances have been made?

When the tare is so much on a given quantity gross, how do you work to obtain the neat?

When the tare is so much on the bag, box, barrel, &c. how do you obtain the neat?

When the tare is so much on the hundred weight, how do you obtain the neat?

When tare and tret are both allowed, how do you obtain the neat?

Examples.—Case 1.

1. What is the neat weight of 1 hogshead of tobacco, weighing 5 cwt. 2 qr. 15 lb. gross, when the tare is 3 qr. 7 lb.?

Cwt.	*qr.*	*lb.*	
5	2	15	
	3	7	
4	3	8	*Ans.*

2. What is the neat weight of 8 hogsheads of sugar, each weighing 7 cwt. 3 qr. 20 lb.; tare in the whole, 5 cwt. 1 qr. 19 lb.? *Ans.* 58*cwt.* 0*qr.* 1*lb.*

3. How much is the neat weight of a hogshead of tobacco, weighing gross 6 cwt. 2 qr. 5 lb.; tare 39 lb.? *Ans.* 6*cwt.* 0*qr.* 22*lb.*

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* Four pounds on the 104 lb. is the usual allowance for tret; the reason therefore why we divide by 26 is, that 4 is $\frac{1}{26}$ of 104.

4. What is the neat weight of 369 cwt. 2 qr. 21 lb. gross weight of tobacco; tare in the whole, 10 cwt. 1 qr. 12 lb.? *Ans.* 359*cwt.* 1*qr.* 9*lb.*

5. How much is the neat weight of 8 hogsheads of sugar, each weighing 5 cwt. 1 qr. 19 lb. gross; tare in the whole, 2 cwt. 0 qr. 23 lb.? *Ans.* 41*cwt.* 0*qr.* 17*lb.*

6. What is the neat weight of 3 barrels of indigo, weighing as follows: viz. No. 1, 3 cwt. 2 qr. 19 lb. gross; tare 34 lb.—No. 2, 6 cwt. 0 qr. 13 lb. gross; tare 57 lb.—No. 3, 4 cwt. 3 qr. 5 lb. gross; tare 46 lb.?

Ans. 13*cwt.* 1*qr.* 12*lb.*

Case 2.

1. How much is the neat weight of 7 casks of sugar, each weighing 3 cwt. 2 qr. 12 lb. gross; tare 25 lb. per cask?

Cwt. qr. lb.	*lb.*
3 2 12	25
7	7
25 1 0	28)175(4)6
1 2 7	168
	1 2*qr.*
23 2 21	7*lb.*

2. What is the neat weight of 7 hogsheads of sugar, each weighing 4 cwt. 2 qr. 24 lb. gross; tare, 2 qr. 18 lb. per hogshead? *Ans.* 28*cwt.* 1*qr.* 14*lb.*

3. Sold 6 casks of indigo, weighing gross 21 cwt. 2 qr. 21 lb.; tare, 2 qr. 3 lb. per cask: what is the neat weight, and value thereof at $5.50 per cwt.?

Ans. { Neat, 18*cwt.* 2*qr.* 3*lb.*
{ Value, $101 89*cts.* 7*m.*+

4. Bought 9 casks of raisins, each weighing 2 cwt. 1 qr. 25 lb. gross; tare, 30 lb. per cask: what is the neat weight thereof, and value at $5.10 per cwt.?

Ans { Neat, 19*cwt.* 3*qr.* 11*lb.*
{ Value, $101 22*cts.* 5*m.*+

Case 3.

1. How much is the neat weight of 25 kegs of raisins,

each, gross, 1 cwt. 2 qr. 15 lbs.; tare, 19 lb. per hundred weight?

		Cwt.	qr.	lb.	
		1	2	15	
					5×5=25
		8	0	19	
				5	
16	$\frac{1}{7}$	40	3	11	
2	$\frac{1}{8}$	5	3	9	
1	$\frac{1}{2}$	0	2	25	
		0	1	12	
		6	3	18	
		33	3	21	*Ans.*

2. What is the neat weight of 4 hogsheads of sugar, each weighing 7 cwt. 3 qr. 14 lb. gross; tare, 20 lb. per hundred weight? *Ans.* 25*cwt.* 3*qr.* 14*lb.*

3. What is the neat weight and value of 10 hogsheads of tobacco, each weighing 5 cwt. 1 qr. 13 lb. gross, and 16 lb. tare per cwt., at 8 dollars and 75 cents per cwt.?
Ans. { Neat, 46*cwt.*
Value, $402 50*cts.*

4. What is the neat weight and value of 6 hogsheads of sugar, each weighing 4 cwt. 1 qr. 24 lb. gross; tare, 18 lb. per cwt.; at 7½ cents per pound?
Ans. { Neat, 22*cwt.* 1*qr.* 27*lb.*
Value, $188 92*cts.* 5*m.*

Case 4.

1. There are 17 boxes of sugar, each 1 cwt. 3 qr. 18 lb. gross; tare, 16 lb. per cwt.; tret, 4 lb. per 104 lb.: what is the neat weight, and what is the value at 7 dollars and 60 cents per cwt.?

		Cwt.	qr.	lb.	
		1	3	18+1	
				4×4=16	
		7	2	16	
				4	
		30	2	8	
		1	3	18	
16	$\frac{1}{7}$	32	1	26	
		4	2	15	
		27	3	11	suttle.
4	$\frac{1}{26}$	1	0	7	
		26	3	4	neat.

qr.		$	cts.	
2	$\frac{1}{2}$	7	60	
			26	
		45	60	
		152	0	
qr.		197	60	
1	$\frac{1}{2}$	3	80	
lb. 4	$\frac{1}{7}$	1	90	
			27	
		203	57	value.

2. What is the neat weight and value of 12 bags of coffee, each 2 cwt. 1 qr. 10 lbs. gross; tare, 18 lb. per cwt.; tret, 4 lb. per 104 lb.; at $19.60 per cwt.?

Ans. { Neat, *22cwt. 2qr. 18lb*
{ Value, $444 15*cts.*

3. In 6 hogsheads of sugar, each weighing 4 cwt. 1 qr. 11 lb. gross; tare, 1 qr. 5 lb. per hogshead; tret, 4 lb. per 104 lb.: what is the neat weight, and value at $6.75 per cwt.?

Ans. { Neat, *23cwt. 1qr. 16lb.*
{ Value, $157 90*cts.*

Application.

1. At 23$\frac{1}{4}$ cents per pound, what will 13 bags of coffee come to, weighing gross 17 cwt. 3 qr. 22 lb, tare in the whole, 3 qr. 14 lb.? *Ans.* $444 54*cts.*

2. There are 15 hogsheads of sugar, each hogshead weighs 5 cwt. 2 qrs. 19 lb. gross; tare per hogshead, 2 qr. 25 lb.: what will the sugar amount to, at $6.75 per cwt.?

Ans. { Neat, *74cwt. 0qr. 22lb.*
{ Value, $500 82*cts.*

3. At $3.75 per cwt., what will 4 hogsheads of tobacco come to, weighing gross, viz. No. 1, 6 cwt. 3 qr.

18 lb.—No. 2, 7 cwt. 0 qr. 10 lb.—No. 3, 5 cwt. 3 qr. 26 lb.—No. 4, 8 cwt. 0 qr. 3 lb.; tare, 12 lb. per cwt.?

Ans. { Neat, 25*cwt.* 0*qr.* 1*lb.*
Value, $93 78*cts.* 3*m.*+

4. What is the cost of 24 casks of prunes, each cask weighing 1 cwt. 1 qr. 23 lb. gross; tare, 18 lb. per cask; at $5.17½ per cwt.?

Ans. { Neat, 31*cwt.* 0*qr.* 8*lb.*
Value, $160 79*cts.* 4*m.*

5. Bought 15 boxes of sugar, each box weighin 1 cwt. 1 qr. 13 lb. gross; tare, 22 lb. per box: what wa the neat weight, and amount at $9.64 per cwt.?

Ans. { Neat, 17*cwt.* 2*qr.* 5*m.*
Value, $169 13*cts.*+

6. What is the neat weight and value of 10 hogshead of sugar, each hogshead weighing 6 cwt. 2 qr. 14 lb gross; tare, 18 lb. per cwt.; tret, 4 lb. per 104 lb.; a 11½ cents per lb.?

Ans. { Neat, 53*cwt.* 1*qr.* 25*lb.*
Value, $688 73*cts.* 5*m.*

* * *

INTEREST.

Interest is an allowance made for the use of money.

In computing interest, four things are to be particu larly observed; viz principal, time, rate per cent., an amount.

Principal is the sum for which interest is to be com puted.

Rate per cent. per annum is the interest of 100 dollar or pounds for one year.

Time is the number of years, months, &c. for which interest is to be computed.

Amount is the principal and interest added together.

Case 1.

When the time is one year, and the rate per cent. i any number of dollars or pounds.

Rule.—Multiply the dollars or pounds by the rate per cent., and divide by 100; the quotient will be the interest for one year.

Note.—When the rate per cent. is not equal to a whole number, but consists of a fraction, such as ¼, ½, or ¾, the aliquot parts of the principal must be taken; after which, divide by 100 for the interest.

Note 2.—When the rate per cent. is any number of dollars or pounds, and ¼, ½, or ¾, say 4¼, 4½, or 4¾ per cent., multiply the principal by the whole number, and add, ¼, ½, or ¾ of the principal to the product, then divide by 100 as before.

Case 2.

When the interest is required for several years.

Rule.—Find the interest for one year, and multiply the interest for one year by the number of years for which the interest is required.

Note.—If the interest is required for years and months, multiply the interest for 1 year by the number of years, and add aliquot parts for the months of the interest for 1 year.

Case 3.

When the interest is required for any number of months, weeks, or days, less or more than one year.

Rule.—1. Find the interest of the given sum for 1 year.

2. Then, as 1 year is to the given time, so is the interest of the given sum for 1 year to the interest for the time required.

Case 4.

To find the interest of any sum for any number of days, as computed at banks.

Rule 1.—Multiply the dollars by the number of days, and divide by 6; the quotient will be the answer in mills.

Rule 2.—The interest of any number of dollars for 60 days, at 6 per cent., will be exactly the number of cents; and if any other rate per cent. is required, take aliquot parts, and add or subtract according as the rate per cent. is more or less than 6.

Case 5.

The amount, time, and rate per cent. given, to find the principal.

Rule.—1. Find the amount of 100 dollars for the time required, at the given rate per cent.

2. Then, as the amount of 100 dollars for the time required, at the given rate per cent., is to the amount given, so is 100 dollars to the principal required.

Case 6.

The principal, amount, and time given, to find the rate per cent.

Rule.—1. Find the interest for the whole time given, by subtracting the principal from the amount.

2. Then, as the principal is to 100 dollars, so is the interest of the principal for the given time, to the interest of 100 dollars for the same time.

3. Divide the interest last found by the time, and the quotient will be the rate per cent.

Case 7.

To find the time, when the principal, amount, and rate per cent. are given.

Rule.—Divide the whole interest by the interest of the principal for one year, and the quotient will be the time required.

COMPOUND INTEREST.

Compound interest is that in which the interest for one year is added to the principal, and that amount is the principal for the second year; and so on for any number of years.

Rule.—1. Find the amount of the given sum for the first year by simple interest, which will be the principal for the second year; then find the amount of the principal for the second year for the principal for the third year; and so on for any number of years.

2. Subtract the first principal from the amount, and the remainder will be the compound interest required.

Questions.

What is interest?

What four things are to be particularly observed in computing interest?

What is principal?

What is rate per cent.?

What is time?

What is amount?

Repeat the rule for finding the interest, when the time is one year, and the rate per cent. is any number of dollars or pounds.

What is to be noted when the rate per cent. is less than a whole number, but consists of a fraction, such as $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$?

What is to be noted when the rate per cent. is any number of dollars, with a fraction; say $4\frac{1}{4}$, $4\frac{1}{2}$, $4\frac{3}{4}$, or the like?

How do you proceed when the interest for several years is required?

What is to be noted if the interest is required for years and months?

When the interest is required for any number of weeks or days, less or more than one year, by what rule do you perform the operation?

How do you proceed to find the interest, at 6 per cent., for any number of days, as computed at banks?

What is to be observed when the interest is at any other rate than 6 per cent.?

Repeat the rule to find the principal, when the amount, time, and rate per cent. are given?

How do you proceed, when the principal, amount, and time are given, to find the rate per cent.?

How do you find the time, when the principal, amount, and rate per cent. are given?

What is compound interest?

How is compound interest computed?

Examples in Case 1,

1. What is the interest of 500 dollars for 1 year, at 6 per cent. per annum?

(1) $500
6

100÷$30|00 *Ans.*

2. What is the interest of 225 dollars for 1 year, at dollars per cent. per annum? *Ans.* $15.75.

3. What is the interest of 384 dollars 50 cents, for year, at 5 dollars per cent. per annum? *Ans.* $19.22½.

4. What is the interest of £580 10*s.* for 1 year, at £ per cent. per annum? *Ans.* £34 16*s.* 7*d.*

5. What is the interest of 1654 dollars 81 cents for year, at 5 dollars per cent. per annum? *Ans.* $82.74.+

6. What is the interest of 1500 dollars, for 1 year, at dollar per cent. per annum? *Ans.* $7.50.

7. What is the interest of £350, at 5¼ per cent. per annum, for 1 year? *Ans.* £18 7*s.* 6*d.*

8. What is the interest of 524 dollars, for 1 year, 5¼ dollars per cent. per annum? *Ans.* $27.51.

9. What would be the interest of 842 dollars, for year, at 5½ dollars per cent. per annum? *Ans.* $46.31.

Case 2.

1. What is the interest of 500 dollars, for 4 years, 6 dollars per cent. per annum?

$500
6

30 00
4

$120 00 *Ans.*

2. What will be the interest of 540 dollars, for years, at 5 dollars per cent. per annum? *Ans.* $54.00

3. What is the interest of £124 5*s.* 6*d.* for 3 years, £4 per cent. per annum? *Ans.* £14 18*s.* 3*d.*

4. What would be the interest of 482 dollars, for years, at 6 dols. per cent. per annum? *Ans.* $202.44.

Case 3.

1. What is the interest of £560, for 2 years and months, at £5 per cent. per annum?

£560
5

m. | ½ | 28|00 Int. for 1 year.
6 | | 2

56 Int. for 2 years.
14 — ½ year.

£70 *Ans.*

2. What is the interest of 325 dollars, for 4 years and 2 months, at 4 dollars per cent. per annum?
Ans. $54.16*cts.* 6*m.*

3. What is the interest of 640 dollars, for 5 years and 3 months, at 4 dollars per cent. per annum?
Ans. $176.40.

4. What is the interest of 840 dollars, for 5 years and 4 months, at 7 dollars per cent. per annum?
Ans. $313.60.

5. What is the interest of 560 dollars, for 4 months, at 6 dollars per cent. per annum?

560
6

100)33 60 — *m.* *m.* $ *cts.* $ *cts.*
As 12 : 4 :: 33 60 : 11 20 *Ans.*

6. What is the interest of 1200 dollars, for 15 weeks, at 5 dollars per cent. per annum? *Ans.* $17.30.

7. What will be the interest of 240 dollars, for 61 days, at 4¾ dollars per cent. per annum? *Ans.* $1.90.+

8. What is the interest of £1000, for 14 months, at £7 per cent. per annum? *Ans.* £81 13*s.* 4*d.*

9. What is the interest of 450 dollars, for 6 months and 20 days, at 5½ dollars per cent. per annum?
Ans. $13.75.

10. What is the interest of 375 dollars 25 cents, for 3 years 2 months 3 weeks and 5 days, at 6 dollars per cent. per annum? *Ans.* $72.85.+

Case 4.

1. What is the interest of 563 dollars, for 60 days, at 6 per cent. per annum; and likewise at 7 per cent. per annum?

$563
60
———
6)33780
———
Ans. 5630 mills.

$563
60
———
6)33780
———
1 | $\frac{1}{6}$ | 5630
938
———
Interest at 7 per cent. 6568 mills.

2. What is the interest of 854 dollars, for 30 days, at 6 per cent. per annum? *Ans.* $4.27.

3. What is the interest of 1100 dollars, for 48 days, at 6 per cent. per annum? *Ans.* $8.80.

4. What is the interest of 3459 dollars, for 75 days, at 6 per cent. per annum? *Ans.* $43 23*cts.* 7*m.*+

5. What is the interest of 1500 dollars, for 60 days, at 5 per cent. per annum? *Ans.* $12.50.

Case 5.

1. What principal, at interest for 8 years, at 5 per cent. per annum, will amount to 840 dollars?

8 years.
5 dollars.
—
40 Int. of $100 for 8 years.
100
———
140 Amount of $100 for 8 years.

$ $ $ $
140 : 840 : : 100 : 600 *Ans.*

2. What principal, at interest for 6 years, at 4 per cent. per annum, will amount to £1240? *Ans.* £1000.

3. What principal, at interest for 5 years, at 6 per cent. per annum, will amount to 2470 dollars? *Ans.* $1900.

Case 6.

1. At what rate per cent. per annum, will 600 dollars amount to 744 dollars, in 4 years?

$		$	
600		744	amount.
4	years.	600	principal.
2400		144	interest.

$ $ $ $
2400 : 144 :: 100 : 6 per cent. *Ans.*

2. At what rate per cent. per annum, will 1200 pounds amount to 1476 pounds, in 5 years and 9 months?
Ans. 4 per cent.

3. If 834 dollars, at interest 2 years and 6 months, amount to 927 dollars 82½ cents, what was the rate per cent. per annum? *Ans.* 4½ per cent.

Case 7.

1. In what time will 400 dollars amount to 520 dollars, at 5 per cent. per annum?

$	$
400	520
5	400
20|00	120

$ Y. $ Y.
20 : 1 :: 120 : 6 *Ans.*

2. In what time will £1600 amount to £2048, at 4 per cent. per annum? *Ans.* 7 *years.*

3. Suppose 1000 dollars, at 4½ per cent. per annum, amount to 1281 dollars 25 cents, how long was it at interest? *Ans.* 6 *Y.* 3*mo.*

COMPOUND INTEREST.

1. What is the compound interest of 150 dollars for 5 years, at 4 per cent. per annum?

$150
4

6|00 int. 1 yr.

$150
6 int. 1st year.

156 amount 1st year.
6.24 int. 2d year.

162.24 amount 2d year.
6.48.9 int. 3d year.

168.72.9 amount 3d year.
6.74.9 int. 4th year.

175.47.8 amount 4th year.
7.01.9 int. 5th year.

182.49.7 amount 5th year.
150.00.0 principal.

32.49.7 compound int. for 5 years.

2. What is the compound interest of 760 dollars, for 3 years, at 6 dollars per cent. per annum?
Ans. $145 17*cts.* 2*m.*+

3. What is the compound interest of £242 10*s.* 6*d.*, for 4 years, at £5 per cent. per annum?
Ans. $63 13*s.* 1*d.*+

4. What is the amount of 1300 dollars, for 3 years, at 5 dollars per cent. per annum, compound interest?
Ans. $1504 91*cts.* 2*m.*+

5. How much is the amount of 3127 dollars, for 4 years, at 4½ dollars per cent. per annum, compound interest? *Ans.* $3729 00*cts.* 5*m.*

Promiscuous Examples.

1. What is the interest of 620 dols. 25 cents, for 5 years, at 5¼ per cent. per annum? *Ans.* $170 56*cts.* 8*m.*

2. What is the interest of £420, for 1 year, at 7 per cent. per annum? *Ans.* £29 8*s.*

3. What is the interest of 1450 dollars, for 60 days, at 6 per cent per annum? *Ans.* $14 50*cts.*

4. What is the compound interest of £626 5s., for 3 years, at $5\frac{1}{4}$ per cent. per annum? *Ans.* £103 18*s.* $0\frac{3}{4}$*d.*+

5. What is the interest of £1659, for 3 weeks, at 4 per cent per annum? *Ans.* £3 16*s.* $4\frac{1}{2}$*d.*

6. In what time will 500 dollars amount to 1000 dols. at 8 per cent. per annum? *Ans.* 12*Y.* 6*mo.*

7. What principal, at interest for 6 years and 6 months, at 2 per cent. per annum, will amount to 250 dollars? *Ans.* $221 23*cts.* 9*m.*

8. At what rate per cent. per annum, will £300 amount to £450, in 5 years? *Ans.* 10 per cent.

* * *

INSURANCE, COMMISSION, AND BROKAGE.

INSURANCE, Commission, and Brokage, are allowances made to insurers, factors, and brokers, at such rate per cent. as may be agreed on between the parties.

Rule.

Proceed in the same manner as though you were required to find the interest of the given sum for one year. (See case 1st, Simple Interest.)

Note.—If the stipulated rate is less than 1 per cent., take such aliquot part or parts of the interest at 1 per cent. as the rate is of a dollar or pound.

Questions.

What is Insurance, Commission, and Brokage?

How do you proceed to find the Insurance, Commission, or Brokage?

What is to be noted when the stipulated rate per cent. is less than 1 per cent.?

Examples.

1. What is the commission on 625 dollars, at 4 dollars per cent?

```
          $625
             4
          ----
Ans. $25,00
```

2. What is the commission on £1320, at 5 per cent.? *Ans.* £66.

3. What is the commission on 3450 dollars, at 4½ dollars per cent.? *Ans.* $155.25.

4. The sales of certain goods amount to 1680 dollars; what sum is to be received for them, allowing 2¾ dollars per cent. for commission? *Ans.* $1633.80.

5. What is the insurance of £760, at 6½ per cent.? *Ans.* £49 8s.

6. What is the insurance of 5630 dollars, at 7¾ dollars per cent.? *Ans.* $436 32*cts.* 5*m.*

7. A merchant sent a ship and cargo to sea, valued 17654 dollars: what would be the amount of insurance at 18¾ dollars per cent.? *Ans.* $3310 12½*cts.*

8. What is the brokage on £2150, at £2 per cent.? *Ans.* £43.

9. When a broker sells goods to the amount of 96 dollars 50 cents, what is his commission, at 1¼ dollar per cent.? *Ans.* $12 30*cts.* 6*m.*+

13. If a broker buys goods for me, amounting to 16 dollars 75 cents, what sum must I pay him, allowing him 1½ per cent.? *Ans.* $24 76*cts.* 1*m.*+

◆

DISCOUNT.

Discount is an abatement of so much money from any sum to be received before it is due, as that sum would gain, put to interest for the given time and rate per cent.

Rule.

1. Find the interest of 100 dollars or pounds for the given time, at the given rate per cent.

2. Add the interest so found to 100 dollars or pounds.

3. As 100 dollars or pounds, with the interest for the given time added,
Is to the given sum,
So is 100 dollars or pounds to the present worth.

If the discount be required, subtract the present worth from the given sum, and the remainder will be the discount.

Note.—When discount is made without regard to time, it is found precisely like the interest for one year.

Questions.

What is discount?

What is first to be done, when you wish to find the answer?

After having found the interest of 100 dollars, at the given time and rate per cent., what is next to be done?

After having added the interest so found to 100 dollars or pounds, by what rule do you work to find the discount?

When discount is made without regard to time, how is it found?

Examples.

1. What is the present worth of 420 dollars, due in 2 years, discount at 6 per cent. per annum?

$
6
2
—
12
100
—
112

$ $ $
112 : 420 : : 100
100
—
112)42000(375 dollars. *Ans.*
336
—
840
784
—
560
560
—

2. What is the present worth of 850 dollars, due in 3 months, at 6 per cent. per annum? *Ans.* $837 43*cts.* 8*m.*+

3. What is the discount of 645 dollars, for 9 months, at 6 per cent. per annum? *Ans.* $27 77*cts.* 6*m.*

4. What is the present worth of 775 dollars 50 cents, due in 4 years, at 5 per cent. per annum? *Ans.* $646.25.

5. What is the present worth of 580 dollars, due in 8 months, at 6 per cent. per annum? *Ans.* $557.69.+

6. What is the present worth of 954 dollars, due in 3 years, at 4½ per cent. per annum?
Ans. $840 52*cts.* 8*m.*+

7. What is the discount of 205 dollars, due in 15 months, at 7 per cent. per annum? *Ans.* $16 49*cts.* 5*m.*+

8. Bought goods amounting to 775 dollars, at 9 months' credit: how much ready money must be paid, allowing a discount of 5 per cent. per annum? *Ans.* $746 98*cts.* 7*m.*

9. I owe A. to the value of 1005 dollars, to pay as follows: viz. 475 dollars in 10 months, and the remainder in 15 months: what is the present worth, allowing discount at 6 per cent. per annum? *Ans.* $945 40*cts.* 4*m.*

10. What difference is there between the interest of 2260 dollars, at 6 per cent. per annum, for 5 years, and the discount of the same sum for the same time and rate per cent.? *Ans.* $156 46*cts.* 2*m.*+

11. What is the discount of 520 dollars, at 5 per cent.?

$520
5
$26,00 *Ans.*

12. How much is the discount of £782, at 4 per cent.?
Ans. £31 5*s.* 7*d.*

13. What is the discount of 476 dollars, at 3 per cent.?
Ans. $14.28.

14. Bought goods on credit, amounting to 1385 dollars: how much ready money must be paid for them, if a discount of 6 per cent. be allowed? *Ans.* $1301.90.

15. I hold A.'s note for 650 dollars; but I agree to allow him a discount of 4½ per cent. for present payment: what sum must I receive? *Ans.* $620.75.

◆

EQUATION.

EQUATION is used to find the mean time of several payments due at different times.

Rule.

Multiply each payment by the time at which it becomes due; add the several products together, and divide the amount by the whole sum; the product will be the mean time.

Questions.

For what purpose is Equation used?

By what rule do you find the mean time at which several payments become due?

Examples.

1. I owe A. £200, of which £100 are to be paid at 3 months, and £100 at 9 months; but they agree to reduce them to one payment: when must the whole be paid?

$$\begin{array}{rr} 100\times3 = & 300 \\ 100\times9 = & 900 \\ \hline 200 & 2|00)12|00 \\ \hline \end{array}$$

Ans. 6 months.

2 A merchant has owing to him 500 dollars, to be paid as follows: viz. 250 dollars at 6 months, 250 dollars at 8 months; but it is agreed that the whole shall be paid at one time: when must it be paid? *Ans.* 7*mo.*

3. A. owes B. £300, to be paid as follows: viz. £100 at 2 months, £100 at 4 months, £100 at 6 months; but they have agreed that the whole shall be paid at one time: when must it be paid? *Ans.* 4*mo.*

4. C. owes D. 550 dollars, of which, 100 dollars to be paid at 3 months, 200 dollars at 5 months, and 250 dollars at 8 months; but have agreed to make one payment of the whole: at what time must it be paid? *Ans.* 6*mo.*

* * *

BARTER.

Barter is the exchange of one commodity for another, at such prices as may be mutually agreed on.

Rule.

1. By any rule most convenient, find the value of whatever you propose to exchange, at the price at which you propose to exchange it.

2. As the price of one of the articles which you receive,
Is to the whole quantity,
So is the whole value of what you give in exchange,
To the answer required.

Questions.

What is barter?

What is first to be done, when you propose to barter one commodity for another?

After having found the value of the article you propose to exchange, how do you proceed to find the answer?

Examples.

1. How many pounds of coffee, at 25 cents per pound, must be given in barter for 2 cwt. 2 qr. 13 lb. of sugar, at 9 cents per lb.? *Ans.* 105*lb.* $7\frac{17}{25}$*oz.*

2. What quantity of tea, at 1 dollar 30 cents per pound, must be given for 2500 lb. of rice, at $4\frac{1}{2}$ cents per lb.? *Ans.* 86*lb.* 8*oz.*+

3. How much sugar, at $8\frac{3}{4}$ cents per lb., must be given for 108 lb. of tea, at 1 dollar 25 cents per lb.? *Ans.* 1542*lb.* 13*oz.*

4. A. has rice at 3 dollars and 75 cents per cwt., for which B. is to give him nutmegs, at \$$1.87\frac{1}{2}$ per lb.: how many pounds of nutmegs must A. receive for 14 cwt. 3 qr. 26 lb. of rice? *Ans.* 29*lb.* 15*oz.*+

5. C. has linen, at 35 cents per yard, but in barter he will have 37; D. has 2 cwt. 3 qr. 17 lb. of chocolate, which he would sell for 10 cents per lb., but in barter he will have $12\frac{1}{2}$ cents: how much linen must D. receive for his chocolate? *Ans.* 109*yd.* 3*qr.*

5. How much corn, at 45 cents per bushel, is equal in value to 357 bushels of wheat, at 93 cents per bushel? *Ans.* 737*bu.* 3*pe.*+

7. What quantity of candles, at 9 dollars 50 cents per cwt. must be given for 15 cwt. 0 qr. 27 lb. of tobacco, at 20 cents per lb.? *Ans.* 35*cwt.* 3*qr.* 20*lb.*+

8. E. has 5 pieces of muslin, each piece containing 95 yards, at 23 cents per yard, for which F. is to give him 32 sheep, at 2 dols. 50 cents each, and the remainder in rye flour, at 1 dol. and 50 cents per hundred: how many hundreds of rye flour must E. receive? *Ans.* 19*cwt.* 2*qr.*

9. A merchant has 1286 yards of linen, at 43 cents per yard, for which he is to receive 2 cwt. 1 qr. 13 lb. of chocolate, at 14 cents per lb., and the rest in money: how much money will he receive? *Ans.* $515.88.

10. A. has 570 lb. of sugar, at 7 cents per lb., for which B. is to give him cheese, at 11½ cents per lb.: how much cheese will A. receive? *Ans.* 346*lb.* 15*oz.*+

11. G. gave 112 cwt. of iron, at 5 dols. 4 cents per cwt., for which he received 1208 yards of cloth: what was the cloth per yard? *Ans.* 46*cts.* 7*m.*+

12. A grocer had sugar at 8 cents per lb., for some of which B. gave 750 lb. of tea, at 1 dol. 8 cents per lb.: how many lb. of sugar must B. receive for his tea? *Ans.* 90*cwt.* 1*qr.* 17*lb.*

13. C. gave 2 hogsheads of brandy, at 75 cents per gallon, to D., for 56 yards of cloth: what was the cloth per yard? *Ans.* $1.68¾.

14. E. has 2108 lb. of flax, at 10 cents per lb., and 31 dozen of eggs, at 11½ cents per dozen, which he barters with F. thus: to have 135 dols. 25 cents in money, and the rest in pork, at 1 dol. 58 cents per barrel: how many barrels is he to receive? *Ans.* 50 barrels.+

15. Two persons barter: A. has 17 cwt. of hams, at 13½ cents per lb.; B. has 1200 lb. of cheese, at 14 dollars per cwt.: which of them must receive money, and how much? *Ans.* A. $107.04.

16. C. has sugar, which he barters with D. at 5 cents per lb. more than it cost him, against coffee, which stands D. 20 cents a lb., but he put it to 25 cents: how much did the sugar cost at first? *Ans.* 20*cts.*

17. E. has flannel worth 50 cents per yard ready money, but in barter he will have 56 cents; H. has muslin worth 31¼ cents in ready money: at what price ought the muslin to be rated in barter? *Ans.* 35*cts.*

18. S. bought of W. 105 tons of iron, at 10 dollar cents per ton, and is to pay him as follows: viz. in ca 650 dollars; 250 lb. of leather, at 20 cents per lb.; and loads of coal, each load containing 15 bushels, at 45 ce per bushel; 85 gallons of brandy, at the rate of 75 dolla per hogshead; and the rest in coffee, at 30 cents per lb.: how much coffee is W. to receive? *Ans.* 615*lb.* nearly

LOSS AND GAIN.

Loss and Gain is made use of to find the loss or gain sustained by buying or selling any commodity.

When you buy any commodity at a certain price, and sell the same at any other price, more or less, to ascertain the gain or loss on the whole.

Rule.

1. Find the whole amount you paid for it.
2. Find the sum it sold for.
3. If the sum it sold for be more than you paid for it, subtract the sum you paid from the sum you sold it for, and the remainder will be the gain.
4. But if you sold it for less than you gave, subtract the sum you sold for, from the sum you paid, and the remainder will be your loss.

When you wish to sell any commodity at a certain gain per cent., and are desirous to know what sum it must be sold for.

As 100 is to the prime cost,
So is 100, with the gain per cent. added, to the amount it must sell for.

When the amount, at a certain rate gain per cent., is given to find the prime cost.

As 100, with the rate per cent. added,
Is to the amount,
So is 100
To the prime cost.

When any commodity is sold at a certain rate per cent. loss, to find the sum received.

As 100 is to the prime cost,
So is 100, less the per cent. lost
To the sum received.

When the sum received on selling any commodity at a certain rate per cent. loss, is given to find the prime cost.

As 100, less the rate per cent. lost, is to the sum received, so is the sum received, to the prime cost.

Questions.

For what purpose is loss and gain used?

When you buy any commodity at a certain price, and sell it again at any price more or less than you gave for it, what is first to be done?

What is next to be done, after you find what you gave for it?

When you have found what you sold it for, and it is more than you gave for it, what is to be done, to find the gain?

When you have found the sum it sold for, and it is less than you paid for it, how do you ascertain the loss?

By what rule do you proceed, when you wish to sell any thing at a certain gain per cent., and are desirous to know the amount it must be sold for?

When the amount at a certain gain per cent. is given to find the cost, by what rule do you work?

When any commodity is sold at a rate per cent. loss, by what rule do you find the sum received?

How do you proceed to find the prime cost, when the sum received on selling at a rate per cent. loss, is given to find the prime cost?

Examples.

1. A merchant bought 50 yards of linen, at 50 cents per yard, and sold it at 56¼ cents per yard: what is gained in the whole?

y[illegible] *yd.* *cts.*
1 : 50 :: 6¼ gain per yard.
6¼

300
12½

Ans. $3.12½ whole gain.

2. Bought 1763 lb. of sugar, at 8 cents per l
the same at 10 cents per lb.: what was the gain
whole? *Ans.* $3

3. A man bought flour at 5 dollars per barrel, a
it at 5 dollars 25 cents per barrel: what did he
363 barrels? *Ans.* $9

4. If a dry goods merchant purchase 150 y
cloth, at 3 dollars 75 cents per yard, and sell the
3 dollars 90 cents per yard, what would he gain
whole? *Ans.* $2

5. If 18 cwt. 2 qr. of hops be bought at 7 doll
50 cents per cwt., and the same hops sold for 7
and 75 cents per cwt., what will be the gain
whole? *Ans.* $4

6. Purchased 210 reams of paper, at 2 dollars 62
per ream, and sold it for 2 dollars 87½ cents per rea
was the gain on the whole? *Ans.* $5

7. If 1 cwt. of tobacco cost 18 dollars 12½ ce
be sold for 20 dollars 75 cents, what is the gain per
Ans. $2

8. Bought 150 bushels of corn, at 50 cents per
and sold it at 45 cents per bushel: what was the
the whole, and loss per cent.?
Ans. Loss on the whole, $7.50. 10 per

9. A merchant bought 760 lb. of tea, for 810
and sold it at 90 cents per lb.: whether did he
lose, and how much per cent.?
Ans. Lost $126; per cent.

10. If a yard of muslin be bought for 37½ ce
sold again for 32 cents, what is the loss per cent.?
Ans. 14⅔ per

11. When a merchant buys goods, and sells them at an advance of *2d.* per shilling, what does he gain per cent.? *Ans.* 16$\frac{2}{3}$ per cent.

12. A man purchased 7 pieces of muslin, at 13 dollars 75 cents per piece; but finding it somewhat damaged, he paid 3 dollars 12$\frac{1}{2}$ cents per piece for dyeing: how much must each piece be sold for, to gain 12 per cent. on the whole? *Ans.* $18.90.

13 If 1 cwt. of beef be bought for 7 dollars, what must it be sold for per lb., to gain 3 dollars on the whole? *Ans.* 8*cts.* 9*m.*

14. A man paid 23 cents per lb. for 702 lb. of coffee, and sold the same coffee at 19 cents per lb.: what was his loss on the whole? *Ans.* $28.08.

15. A man, when he sold a yard of cloth for 2 dollars 23 cents, gained 10 per cent.: if he had sold it for 2 dollars 75 cents, what would have been the gain per cent.? *Ans.* 35$\frac{2}{3}$ nearly.

16. When 100 boxes of prunes, cost 2 dollars 10 cents each, and by selling them at 3 dollars 50 cents per cwt. the gain is 25 per cent., the weight of each box, one with another, is required? *Ans.* 84*lb.*

17. If A. purchase 16 pieces of cloth, at 14 dollars per piece, and sell 5 pieces, at 17 dollars per piece, and 6 at 15 dollars per piece, what must he sell the rest at per piece, to gain 12 per cent. on the whole? *Ans.* $15 17*cts.* 6*m.*

18. Bought a box of tea, weighing 372 lb., for 410 dollars, and sold it for 500 dollars: what was the gain on each pound? *Ans.* 24*cts.* 1*m.*+

19. When a broker in exchange receives 5 cents per dollar profit, how much is the gain per cent.? *Ans.* $5.00.

20. Bought 5 hogsheads of molasses, containing 510 gallons, at 1 dollar 5 cents per gallon, and sold it at 1 dollar 30 cents per gallon, on a credit of three months; but I would know the gain, allowing for the present worth of the debt at 6 per cent. per annum? *Ans.* $117.70.

FELLOWSHIP.

Fellowship is a rule used to divide the gain or loss which may arise in partnership (when the stock of each partner is not equal) proportionally among them.

Case 1.

When the sums advanced by each of the partners, and the gain or loss on the whole, are given to find the share of gain or loss belonging to each of them.

Rule.

As the sum of the stocks of each of the partners added together,
Is to the sum advanced by each of them,
So is the whole gain or loss,
To the gain or loss of any of the partners.

Case 2.

When the stocks are considered with respect to time.

Rule.

1. Multiply each man's stock by its time, and add the products together.

2. Then as the sum of the whole stock multiplied by the time,
Is to the product of each individual share multiplied by its time,
So is the whole gain or loss
To the gain or loss of each individual.

Questions.

What is Fellowship?

By what rule do you work, when the sums advanced by each of the partners, and the gain or loss on the whole, are given to find the share of gain or loss belonging to each of them?

When the stocks are considered with respect to time, what is first to be done?

After multiplying each man's stock by its time, what is then to be done?

Examples.—Case 1.

1 Three merchants, trading together, gained 500 dollars; A.'s stock was 800 dollars, B.'s stock 700 dollars, C.'s stock was 500 dollars: what was each man's share of the gain?

A.'s stock 800
B.'s stock 700
C.'s stock 500

2000

As 2000 : 800 :: 500 : 200 for A.'s share.
As 2000 : 700 :: 500 : 175 for B.'s share. } *Ans.*
As 2000 : 500 :: 500 : 125 for C.'s share.

2. D., E., and F., trading together, D. put in stock amounting to 500 dollars, E. 400, and F. 300; and by a misfortune lost 300 dollars: I demand the loss that each must sustain, in proportion to the sum he put in?

Ans. D. $125, E. $100, F. $75.

3. A merchant being deceased, worth 1800 dollars, is found to owe the following sums: to A. 1200 dollars, to B. 500 dollars, to C. 700 dollars: how much is each to have in proportion to the debt?

Ans. A. $900, B. $375, and C. $525.

4. Three drovers pay among them 60 dollars for pasture, into which they put 200 cattle, of which A. had 50, B. 80, and C. 70: I would know how much each had to pay? *Ans.* A. $15, B. $24, C. $21.

5. A man failing, owes the following sums: to A. 120 dollars, to B. 250 dollars 75 cents, to C. 300 dollars, to D. 208 dollars 25 cents; and his whole effects were found to amount to but 650 dollars: what will each one receive, in proportion to his demand?

Ans. A. $ 88.75.+ C. $221.84.+
B. $185.42.+ D. $153.99.+

6. A., B., and C. are to divide 900 dollars; A. is to have a certain portion, B. as much again as A., and C. three times as much as B.: I would know each man's part? *Ans.* A. $100, B. $200, C. $600.

7. If a man is indebted to A. 250 dollars 50 cen
B. 500 dollars, to C. 349 dollars 50 cents, but wh
comes to make a settlement, it is found he is wort
960 dollars, how much will each one receive, if it
proportion to their respective claims?

Ans. A. $218 61*cts.* 8*m*
B. $436 36*cts.* 3*m*
C. $305 01*ct.* 8*m*

Examples.—Case 2.

1. Three men traded together; L. put in 88 doll
3 months, M. 120 dollars for 4 months, and N. 300 d
for 6 months; they gained 184 dollars: what will
man receive of the gain?

Ans. L. $ 19 09*cts.*
M. $ 34 71*cts.*
N. $130 18*cts.*

2. Three persons, A., B., and C., made a stock
months; A. put in, at first, 580 dollars, and, three m
after, he put in 100 dollars more; B. put in, at first,
dollars, and, after 9 months, he put in 200 dollars;
in, at first, 480 dollars; 3 months after, he took ou
dollars; and 2 months after, he put in 500 dollars;
months after this, he took out 400 dollars; and 1
after, he put in 1000 dollars; at the end of 12 m
their gain was found to be 2108 dollars 44 cents: I de
each man's share of the gain.

Ans. A. $581 64*cts.* 8
B. $932 41*cts.* 4
C. $594 37*cts.* 7

EXCHANGE.

Exchange is a rule used to change the currency
state or country into that of other states or countri

Par is a term used to denote equality in value; b
course of exchange between countries is frequently
or below par.

Agio is a term used in some countries to denote the difference between current and bank money.

Exchange is of two kinds, Foreign and Domestic.

DOMESTIC EXCHANGE.

Rules for changing the currency of the United States to Sterling money, and to the currency of other states, and to Federal money.

To change the currency of each of the United States and Sterling money to their value in Federal money.

Rule.

Reduce the given sum to pence, and divide the product by the number of pence which make a dollar.

1. How many dollars are there in £63 14*s.* 6*d.* in Virginia or New England currency? *Ans.* $212.41½.

2. Exchange £230 10*s.* 7*d.* North Carolina or New York currency to dollars. *Ans.* 576 32*cts.* 2*m.*+

To bring dollars, or dollars and cents, to pounds.

Rule.

Multiply the dollars, or dollars and cents, by the pence in a dollar of the currency into which you wish to bring the given sum, the answer will be pence, which bring to pounds; or work as directed by the practical theorems in the table on page 120.

Note.—When there are cents in the given sum, two figures must be cut off from the right of the product, before bringing them to pounds.

3. How many pounds Pennsylvania currency are there in $150? *Ans.* £56 5*s.*

4. Bring $377.40 to pounds Massachusetts currency. *Ans.* £113 4*s.* 4*d.*

5. What number of pounds Georgia currency are equal to $389.45? *Ans.* £90 17*s.* 5*d.*

A TABLE,

Exhibiting the value of a dollar in each of the United States; and practical theorems for exchanging the currency of either into that of any other.

To exchange from — To	New England states and Virginia.	Pennsylvania, New Jersey, Delaware, and Maryland.	New York and N. Carolina.	S. Carolina and Georgia.
New England States* and Virginia.	Dollar 6*s.* 0*d.*	Add one 4th	×4÷3	×2÷9
Pennsylva., N. Jersey, Dela., and Maryland.	×8÷10	Dollar 7*s.* 6*d.*	Add one 5th.	×28÷45
New York and North Carolina.	×3÷4	Subtract one 16th.	Dollar 8*s.* 0*d.*	×7÷12
South Carolina and Georgia.	×9÷7	×45÷28	×12÷7	Dollar 4*s.* 8*d.*

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* The New England States are, Vermont, New Hampshire, Massachusetts, Maine, Rhode Island, and Connecticut.

FOREIGN EXCHANGE.

Questions in Foreign Exchange are solved by th Rule of Three, or by Practice; or may be worked. b rules found by considering the proportions which they b to each other, which will frequently be shorter.

TABLE OF FOREIGN COINS.

FRANCE.

12 Deniers - - - 1 Sol,
20 Sols - - - 1 Livre,
3 Livres - - - 1 Crown.

SPAIN.

4 2½	Marvadies Vellon, or Marvadies of Plate	1 Quarta,
8½ 34	Quartas, or Marvadies Vellon	1 Rial Vellon,
16 34	Quartas, or Marvadies of Plate	1 Rial of Plate,
8	Rials of Plate	1 Piastre,
10	Rials of Plate	1 Dollar,
5	Piastres	1 Spanish Pistole.

ITALY.

12	Deniers	1 Sol,
20	Sols	1 Livre, or Pezzo,
5	Livres	1 Piece of Eight at Genoa,
6	Livres	1 do. at Leghorn,
6	Soldi	1 Gross,
24	Grosses	1 Ducat.

PORTUGAL.

400	Reas	1 Crusadoe,
1000	Reas	1 Milrea.

HOLLAND.

8	Pennings	1 Groat,
2	Groats	1 Stiver,
6	Stivers	1 Shilling,
2½	Florins	1 Rix Dollar,
6	Florins	1 Pound, Flemish,
5	Guilders*	1 Ducat.

DENMARK.

12	Phence	1 Schilling,
16	Schillings	1 Mark,
6	Marks	1 Rix Dollar,
32	Rustics	1 Copper Dollar,
6	Copper Dollars	1 Rix Dollar.

RUSSIA.

100	Copecs	1 Ruble,
18	Pennings	1 Gross,

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* A stiver is estimated at 2 cents; and a florin or guilder at 40 cents.

30 Gross - - - 1 Florin,
3 Florins - - - 1 Rix Dollar,
2 Rix Dollars - - - 1 Gold Ducat.

Accounts in Great Britain, Ireland, and the British We
Indies, are kept in pounds, shillings, and pence; but th
value of a pound is different in different places.

Examples.

1. What is the value of £365 14*s.* 8*d.* Sterling, in Federal money?

£ £ *s.* *d.* $ *cts.* *m.* $ *cts.* *m.*
1 : 365 14 8 : : 4 44 4 : 1625 31 8 *Ans.*

2. Reduce £76 Irish, to Federal money.
Ans. $311 60*cts.*

3. What number of milreas of Portugal are equal
532 dollars 33 cents? *Ans.* 429 *milreas* 298+ *reas*

4. How many rubles of Russia, at 66 cents each,
equal to 1869 dollars? *Ans.* 2831$\frac{9}{11}$ *rubles.*

5. In 165 guilders of Holland, how many dollars?
Ans. $64 35*cts.*

6. If I had 280 dollars 58 cents 5 mills, what num
of marks banco of Hamburgh should I receive for
same? *Ans.* 837+ *marks banco*

7. Bring 562 livres of France to Federal money.
Ans. $103 97*cts*

8. Reduce 463 dollars, to reals plate of Spain.
Ans. 4630 *reals plate*

To change current money into banco, and banco
current money, say, as 100, with the agio added to it,
100, so is any given sum current money, to its value
banco.—And, as 100 is to 100 with the agio added to
so is any given sum banco, to its value in current mone

9. What must be paid in Philadelphia for an invoice
goods, charged at 591 florins 17 stivers, allowing the
change at 40 cents per florin, or 2 cents per stiver,
advancing on the invoice 60 per cent.?
Ans. $378 78*cts.*

10. Hamburgh is indebted to Britain 2464 marks current money: for how many marks may Britain draw on the bank, the agio being 25 per cent.?

Ans. 1971 *marks* 3*sch.* 2$\frac{2}{5}$*phen.*

11. What Sterling must be paid in London, to receive in Paris 2000 crowns; exchange 32$\frac{1}{2}$*d.* per crown?

Ans. £270 16*s.* 8*d.*

12. In 1676 dollars 6 rials, how much Sterling; exchange at 36*d.* Sterling per piastre? *Ans.* £314 7*s.* 3*d.*

13. How much Sterling money is equivalent to 3940 pezzos 15 sols of Genoa; exchange at 54*d.* Sterling per pezzo? *Ans.* £886 13*s.* 4$\frac{1}{2}$*d.*

14. In 2586 rubles, how many pounds Sterling; exchange at 4*s.* 3*d.* Sterling per ruble? *Ans.* £549 10*s.* 6*d.*

15. A merchant in London remits to his correspondent at Petersburgh £450 15*s.* Sterling; exchange, 34*s.* 6*d.* Flemish per pound Sterling for Amsterdam, and the exchange thence at 50 stivers per ruble: how many rubles must the correspondent receive? *Ans.* 1866*ru.* 10$\frac{1}{2}$*copecs.*

16. In £813 3*s.* 6*d.* Irish, how much Sterling at par?

Ans. £750 12*s.* 6*d.* Ster.

17. If exchange from London to Amsterdam be 33*s.* 6*d.* per pound Sterling; and if exchange from London to Paris be 32$\frac{1}{2}$*d.* per crown; what must be the rate of exchange from Amsterdam to Paris, in order to be on par with the other two? *Ans.* 54$\frac{7}{16}$*d.* Flemish per crown.

18. If exchange from Paris to London be 32$\frac{1}{2}$*d.* Sterling per crown; and if exchange from Paris to Amsterdam be 54$\frac{7}{16}$*d.* Flemish per crown; what must be the rate of exchange between London and Amsterdam, in order to be on par with the other two? *Ans.* 33*s.* 6*d.*

19. If exchange from Amsterdam to Paris be 54$\frac{7}{16}$*d.* Flemish per crown; and if exchange from Amsterdam to London be 33*s.* 6*d.* Flemish per pound Sterling; what must be the rate of exchange between Paris and London, in order to be on par with the other two?

Ans. 32$\frac{1}{2}$*d.* Sterling per crown.

20. London was ordered to remit to Paris 1000 crowns, at 32*d.* Sterling per crown, and to draw for the value upon

Amsterdam at 36*s.* 6*d.* Flemish per pound Sterling; but when the order came up, bills on Paris were at 32$\frac{1}{4}$*d.* Sterling per crown: what must be the rate of exchange with Amsterdam, to compensate the advance on the remittance? *Ans.* 36*s.* 2$\frac{25}{43}$*d.*

21. London was ordered to remit 600 ducats to Venice, at 51*d.* Sterling per ducat, and to draw for the value upon Spain, at 42*d.* Sterling per piastre; but when the order came to hand, bills on Venice were at 53*d.*: at what rate of exchange must London draw upon Spain, to compensate the advance upon the remittance? *Ans.* 43$\frac{11}{17}$*d.*

◆

VULGAR FRACTIONS.

A VULGAR FRACTION is a part of a whole number, and is read by first mentioning the upper part of the fraction, and then the lower, thus: $\frac{1}{6}$, one-sixth; $\frac{7}{8}$, seven-eighths.

The upper part of the fraction is called the numerator, and shows the part of a whole number expressed by the fraction; the lower number is called the denominator, and shows the number of such parts contained in a whole number.

Vulgar fractions are found under four different situations; namely, proper, improper, compound, and mixed.

A proper fraction has its numerator not greater than its denominator; as, $\frac{9}{10}$, $\frac{3}{13}$.

An improper fraction has its numerator greater than its denominator; as, $\frac{25}{5}$, $\frac{37}{21}$.

A compound fraction is expressed by a fraction of another fraction; as, $\frac{3}{4}$ of $\frac{1}{2}$ of $\frac{7}{8}$ of $\frac{3}{10}$.

A mixed number is a whole number, with a fraction following it; as, 7$\frac{1}{2}$, 8$\frac{7}{8}$.

A mixed fraction has a fraction attached either to its numerator or denominator.

Questions.

What is a vulgar fraction; and how is it to be read?

What part of a fraction is called the numerator, and what does it show?

What part of a fraction is called the denominator, and what does it show?

Vulgar fractions are found under four different situations: name them.

What is a proper fraction?

What is an improper fraction?

What is a compound fraction?

What is a mixed fraction?

REDUCTION OF VULGAR FRACTIONS.

Case 1.

To reduce fractions to their lowest terms.

Rule.

Divide the numerator and denominator continually by any number that will divide them both without a remainder: when they cannot both be divided by the same number without a remainder, that is their lowest term.

2.

To reduce a mixed number to an improper fraction.

Rule.

Multiply the whole number by the denominator of the fraction, to which add the numerator, and place the product over the denominator, for a new numerator.

Case 3.

To reduce an improper fraction to a whole or mixed number.

Rule.

Divide the numerator by the denominator, and the product will be a whole number; if there be any remainder, set it over the given denominator, for the numerator of the fraction.

Case 4.

To reduce a compound fraction to a single fraction.

Rule.

Multiply the numerators together for a new numerator, and the denominators for a new denominator, which reduce, if necessary, to their lowest terms.

Case 5.

To find a common denominator.

Rule.

1. Find the least common denominator, by dividing the given denominators by any number that will divide two or more without a remainder.

2. Set the quotients and individual numbers underneath, and continue the division till no two numbers can be lessened.

3. Multiply the quotients and the divisor or divisors, and the product will be the least common denominator; into which, divide each denominator, and multiply the quotient by its own numerator for a new numerator; and place the new numerator over the denominator, and the fractions are expressed in their lowest terms.

Case 6.

To reduce fractions of one denomination to fractions of a greater denomination, but retaining the same value.

Rule.

Reduce the given fraction to a compound fraction, by multiplying it with all the denominations between the given fraction and the one to which it is to be reduced; which reduce to a single fraction.

Case 7.

To reduce the fraction of one denomination to the fraction of another less denomination, but retaining the same value.

Rule.

Multiply the numerator by the parts of the denominator between the given fraction and that to which it is to be reduced, and place the product for a new numerator over the given denominator, which reduce to its lowest terms.

Case 8.

To reduce a fraction to its proper value.

Rule.

Multiply the numerator by the next lowest denomination, and divide by the denominator.

Case 9.

To reduce any given value or quantity to the fraction of any greater denomination.

Rule.

Reduce the given sum to the lowest denomination mentioned for a numerator, and the denomination of which you wish to make it a fraction, to the same name, for a denominator.

Questions.

Repeat the rule for reducing fractions to their lowest terms.

When it is required to reduce a mixed number to an improper fraction, how do you proceed?

When it is required to reduce an improper fraction to a mixed number, how is the operation performed?

Repeat the rule for reducing a compound fraction to a single one.

When you wish to find a common denominator, what is first to be done?

What is to be done in the second place?

What is to be done to complete the operation of finding a common denominator?

Repeat the rule by which you reduce fractions of one denomination to fractions of another denomination, but retaining the same value.

How do you reduce a fraction of one denomination to a fraction of a less denomination, but retaining the same value?

How do you reduce a fraction to its proper value?

By what rule do you reduce any given value or quantity to the fraction of any greater value or quantity?

Examples.—Case 1.

1. Reduce $\frac{14}{63}$ to its lowest terms.

$$\begin{array}{l} 14)63(4 \\ 56 \\ \end{array}$$

Common measure $7)14(2$ $\quad$ $7)\frac{14}{63}=\frac{2}{9}$ *Ans.*

$$\begin{array}{l} 14 \\ \text{—} \end{array}$$

2. Reduce $\frac{108}{144}$ to its lowest terms. *Ans.* $\frac{3}{4}$.
3. Reduce $\frac{126}{234}$ to its lowest terms. *Ans.* $\frac{7}{13}$.

Case 2.

1. Reduce $36\frac{4}{5}$ to an improper fraction.

$36\times5+4=\frac{184}{5}$. *Ans.*

2. Reduce $45\frac{2}{3}$ to an improper fraction. *Ans.* $\frac{137}{3}$.
3. Reduce $1564\frac{3}{5}$ to an improper fraction. *Ans.* $\frac{7823}{5}$.

Case 3.

1. Reduce $\frac{19}{6}$ to its proper terms.

$$\begin{array}{l} 6)19(3\frac{1}{6} \quad \textit{Ans.} \\ 18 \\ \hline \frac{1}{6} \end{array}$$

2. Reduce $\frac{67}{7}$ to its proper terms. *Ans.* $9\frac{4}{7}$.
3 Reduce $\frac{364}{16}$ to its proper terms. *Ans.* $22\frac{12}{16}$.

Case 4.

1. Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ to a single fraction.

$$\frac{1\times2\times3\times4=24}{2\times3\times4\times5=120}\overset{2)}{=}\frac{2}{20}=\frac{1}{5}\text{: Or, }\frac{1}{2}\text{ of }\frac{2}{3}\text{ of }\frac{3}{4}\text{ of }\frac{4}{5}=\frac{24}{120}=\frac{1}{5}.$$

2. Reduce $\frac{6}{7}$ of $\frac{8}{9}$ of $\frac{11}{12}$ of $\frac{13}{17}$ to a single fraction. *Ans.* $\frac{572}{1071}$.
3. Reduce $\frac{7}{12}$ of $\frac{15}{19}$ of $\frac{8}{11}$ of $\frac{6}{13}$ to a single fraction. *Ans.* $\frac{420}{2717}$.

Case 5.

1. Reduce $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$, and $\frac{17}{18}$ to a common denominator.

$$\begin{array}{l} 3)2\ \ 3\ \ 6\ \ 18 \\ \hline 2)2\ \ 1\ \ 2\ \ \ 6 \\ \hline 1\ \ 1\ \ 1\ \ \ 3 \end{array}$$

$3\times2\times3=18$ common denom

$$\left.\begin{array}{r} 2=9\times\ \ 1=\ \ 9 \\ 3=6\times\ \ 2=12 \\ 6=3\times\ \ 5=15 \\ 18=1\times17=17 \end{array}\right\}\text{ new n merat.}$$

2. Reduce $\frac{4}{5}$, $\frac{9}{20}$, $\frac{7}{10}$, and $\frac{4}{15}$, to a common denominator. *Ans.* $\frac{48}{60}$, $\frac{27}{60}$, $\frac{42}{60}$, $\frac{16}{60}$.

3. Reduce $\frac{9}{10}$, $\frac{1}{2}$, and $\frac{5}{9}$, to a common denominator. *Ans.* $\frac{81}{90}$, $\frac{45}{90}$, $\frac{50}{90}$.

Case 6.

1. Reduce $\frac{2}{3}$ of a penny to the fraction of a pound.
$\frac{2}{3}$ of $\frac{1}{12}$ of $\frac{1}{20}=\frac{2}{720}=\frac{1}{360}$£. *Ans.*

2. Reduce $\frac{3}{5}$ of a pennyweight to the fraction of a lb. troy. *Ans.* $\frac{1}{400}$*lb.*

3. Reduce $\frac{3}{8}$ of a nail to the fraction of a yard. *Ans.* $\frac{3}{128}$*yd.*

4. Reduce $\frac{5}{8}$ of a pint to the fraction of a hogshead. *Ans.* $\frac{5}{4032}$*hhd.*

Case 7.

1. Reduce $\frac{4}{1840}$ of a dollar to the fraction of a cent. *Ans.* 4×100 $\frac{400}{1840}=\frac{5}{23}$*ct.*

2. Reduce $\frac{2}{252}$ of a cwt. to the fraction of a lb. avoirdupois. *Ans.* $\frac{8}{9}$*lb.*

3. Reduce $\frac{6}{1680}$ of a pound to the fraction of a penny. *Ans.* $\frac{6}{7}$*d.*

Case 8.

1. Reduce $\frac{4}{5}$ of a dollar to its proper value.
Here: $4\times100\div5=80$*cts.* *Ans.*

2. Reduce $\frac{7}{8}$ of a shilling to its proper value. *Ans.* 10½*d.*

3. Reduce $\frac{12}{48}$ of a day to its proper quantity. *Ans.* 6 *hours.*

4. Reduce $\frac{5}{16}$ of an acre to its proper quantity. *Ans.* 1*R.* 10*P.*

Case 9.

1. Reduce 80 cents to the fraction of a dollar.
In a dollar $\frac{80}{100}$*cts.*$=\frac{4}{5}$. *Ans.*

2. Reduce 5*s.* 4*d.* to the fraction of a pound. *Ans.* $\frac{4}{15}$£.

3. Reduce 6 months 2 weeks to the fraction of a year. *Ans.* $\frac{1}{2}$ *year.*

4. Reduce 2 quarters 3 nails to the fraction of a yard. *Ans.* $\frac{11}{16}$ *yard.*

ADDITION OF VULGAR FRACTIONS.

Rule.

Reduce the fraction to a common denominator, and add the numerators together, for a numerator to the common denominator.

Note.—If a mixed number is given, it is better only to make use of the fractional part in performing the operation, until the fractions are added together; and then add the whole number by simple addition.

Note 2.—If fractions be of different denominations, find the proper value of each separately, and add them together by compound addition.

Note 3.—When all the denominators are alike, add all the numerators together, and place one of the denominators under the amount.

Questions.

Repeat the rule for performing addition of vulgar fractions.

What is to be noted, when a mixed number is given?

What is to be noted, when different denominations are given?

What is to be noted, when all the denominators are alike?

Examples.

1. Add $\frac{1}{6}$, $\frac{1}{8}$, and $\frac{1}{2}$ together.

$$\text{Here: } 2\,\underline{|\,6\quad 8\quad 2}$$
$$\phantom{\text{Here: } 2\,}|\,3\quad 4\quad 1$$

——and $2\times3\times4\times1=24$ common denom.

$$\text{Then}\quad \left.\begin{array}{l} 24\div6\times1=\ \ 4 \\ 24\div8\times1=\ \ 3 \\ 24\div2\times1=12 \end{array}\right\}\text{numerators.}$$

whence $\frac{19}{24}$ *Ans.*

2. Add $\frac{3}{13}$, $\frac{4}{13}$, $\frac{5}{13}$, and $\frac{1}{13}$ together. *Ans.* 1.
3. Add $\frac{4}{7}$, $\frac{3}{7}$, and $\frac{6}{7}$ together. *Ans.* $1\frac{6}{7}$.
4. Add $\frac{2}{5}$ and $\frac{5}{10}$ together. *Ans.* $\frac{9}{10}$.
5. Add $3\frac{1}{4}$, $8\frac{2}{7}$, and $\frac{4}{6}$ together. *Ans.* 11
6. Add $\frac{3}{6}$ of $\frac{5}{8}$, and $\frac{2}{4}$ of $\frac{7}{12}$, together. *Ans.*
7. Add $\frac{1}{3}$ of an acre to $\frac{7}{10}$ of a rood. *Ans.* 2*R.* $1\frac{1}{3}$*P.*

MULTIPLICATION OF VULGAR FRACTIONS.

Rule.

Multiply all the numerators of the given fraction together, for a new numerator, and all the denominators, for a new denominator.

Note.—It will frequently be necessary to prepare the given terms for the operation by the rules of reduction.

Questions.

Repeat the rule for performing multiplication of vulgar fractions.

What is to be noted with respect to the preparation of the given terms?

Examples.

1. Multiply $\frac{5}{7}$ by $\frac{3}{10}$. $\frac{5}{7}\times\frac{3}{10}=\frac{3}{14}$. *Ans.*
2. Multiply $\frac{2}{10}$ by $\frac{1}{3}$. *Ans.* $\frac{1}{15}$.
3. Multiply $6\frac{2}{4}$ by $\frac{1}{7}$. *Ans.* $\frac{13}{14}$.
4. Multiply $4\frac{3}{4}$ by $\frac{2}{3}$. *Ans.* $3\frac{1}{6}$.

SUBTRACTION OF VULGAR FRACTIONS.

Rule.

Reduce the given fraction to a common denominator; then subtract the less numerator from the greater, and place the difference over the common denominator.

But if the lower numerator be greater, subtract it from the common denominator, adding in the upper numerator, and carry one to the units' place of the whole number.

Note.—When the fractions are of different denominations, reduce them to their proper value, and take their difference by compound subtraction.

Questions.

How do you perform subtraction of vulgar fractions?

What is to be done, when the lower numerator is the greater?

What is to be noted, when the fractions are of different denominations?

Examples.

1. From $\frac{5}{8}$ take $\frac{5}{12}$.

$$\text{Here: } 4\,\underline{\big|\,8 \quad 12}\qquad \big|\,2 \quad 3$$

and 4 × 2×3=24 common denominator.

$$\left.\begin{array}{r}\text{Then } 24 \div 8 \times 5 = 15\\ 24 \div 12 \times 5 = 10\end{array}\right\}\text{ numerators.}$$

whence $\frac{15}{24}-\frac{10}{24}=\frac{5}{24}$. *Ans.*

2. From $\frac{10}{20}$ take $\frac{1}{7}$ of $\frac{1}{4}$. *Ans.*
3. From 5 take $\frac{8}{14}$. *Ans.* $4\frac{6}{14}$
4. From $\frac{2}{3}$ of a league take $\frac{7}{10}$ of a mile. *Ans.* 1*M.* 2*fur.* 16po
5. From $5\frac{3}{4}$ take $2\frac{2}{3}$. *Ans.* 3
6. From $\frac{2}{3}$ of $\frac{7}{16}$, take $\frac{1}{4}$ of $\frac{3}{5}$. *Ans.*

DIVISION OF VULGAR FRACTIONS.

Rule.

Prepare the fractions, if necessary; invert the divisor and multiply the numerators together for a new numerator, and the denominators for a new denominator.

Question.

Repeat the rule for performing division of vulgar fractions.

Examples.

1. Divide $\frac{11}{17}$ by $\frac{2}{3}$. $\frac{3}{2})\frac{11}{17}(\frac{33}{34}$. *Ans.*
2. Divide $\frac{5}{9}$ by 3. *Ans.*
3. Divide $6\frac{3}{5}$ by $\frac{1}{3}$. *Ans.* 19
4. Divide $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{2}{3}$. *Ans.*
5. Divide $\frac{1}{7}$ by $\frac{3}{4}$. *Ans.*
6. Divide $\frac{2}{3}$ of $\frac{7}{8}$ by $\frac{1}{7}$ of $\frac{1}{4}$. *Ans.* 1

7. Divide $\frac{1}{2}$ of $17\frac{1}{2}$ by $\frac{3}{4}$. *Ans.* $11\frac{2}{3}$.

8. Divide $\frac{3}{4}$ of $91\frac{78}{97}$ by $\frac{4}{5}$ of $25\frac{9}{10}$. *Ans.* $3\frac{64923}{200984}$.

RULE OF THREE IN VULGAR FRACTIONS.

Rule.

1. Prepare the given terms, if preparation be necessary, by reduction, and state the question as in whole numbers.

2. Then invert the dividing term, and multiply all the numerators together, and all the denominators together, for the answer.

Examples.

1. If $\frac{1}{3}$ of a yard cost £$\frac{2}{9}$, what will $\frac{1}{5}$ of a yard cost?

$$\begin{array}{l} 3\times2\times1= \\ 1\times9\times5= \end{array} 3)\frac{6}{45}=\frac{2}{15}=2s.\ 8d.\quad \textit{Ans.}$$

2. When $3\frac{1}{4}$ yards cost $9\frac{3}{4}$*s.*, what buys $4\frac{3}{4}$ yards?

Ans. 14*s.* 3*d.*

3. How many yards of linen, $\frac{5}{4}$ wide, will be sufficient to line 20 yards of baize, that is $\frac{3}{4}$ yard wide?

Ans. 12 *yards.*

4. How much will pay for 4 pieces of cloth, each $27\frac{3}{4}$ yards, at $15\frac{2}{3}$*s.* per yard? *Ans.* £86 19*s.*

5. What will $\frac{2}{5}$ of a cwt. cost, when $5\frac{3}{7}$ cwt. cost £$31\frac{14}{33}$.? *Ans.* £2 6*s.* $3\frac{18}{19}$*d.*

6. If $\frac{1}{3}$ of a pound of cinnamon bring $\frac{4}{7}$ of a dollar, what will $1\frac{3}{5}$ pounds come to? *Ans.* \$$2.74\frac{2}{7}$.

7. When 10 men can finish a piece of work in $20\frac{2}{3}$ days, in how many days can 6 men do the same?

Ans. $34\frac{4}{9}$ *days.*

8. What will $\frac{1}{3}$ of $2\frac{1}{2}$ cwt. of chocolate come to, when $6\frac{1}{2}$ pounds cost $\frac{3}{4}$ of a dollar? *Ans.* \$$10.76\frac{12}{13}$.

* * *

DECIMAL FRACTIONS.

A **Decimal Fraction** is a part of a whole number or unit, denoted by a point placed to the left of a figure or figures; as, .1, .12, .123.

The first figure after the point denotes so many tenths of a unit; the second, so many hundredths; the third, so many thousandths, and so on.

Decimal fractions are read in the same manner as vulgar fractions: .1 is equal to and reads $\frac{1}{10}$, .12 $\frac{12}{100}$, .123 $\frac{123}{1000}$.

A number consisting partly of whole numbers and partly of decimal fractions, is called a mixed number: as, 1.1, 12.12, 123.123.

It has already been understood that whole numbers, counting from the right towards the left, increase in a tenfold proportion; but decimals, on the contrary, counting from the left towards the right, decrease in a tenfold proportion; as will be better exemplified in the following table.

TABLE.

Whole numbers.									*Decimals.*								
9	8	7	6	5	4	3	2	1	.1	2	3	4	5	6	7	8	9
100 of Millions.	10 of Millions.	Millions.	100 of Thousands.	10 of Thousands.	Thousands.	Hundreds.	Tens.	Units.	Tenth part.	Hundredth part.	Thousandth part.	10 Thous. part.	100 Thous. part.	Millionth part.	10 Millionth part.	100 Millth. part.	1000 Millth. part.

Note.—Ciphers placed after decimal figures, neither increase nor decrease their value: thus, .1, .10, and .100, all express the same value, namely, $\frac{1}{10}$. But ciphers placed between the decimal point and any other figure, decrease their value in a tenfold proportion; as, .1, .01, .001: and they all express different values, namely, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$.

Questions.

What are decimal fractions, and how are they denoted?

How are decimal fractions to be read?

What is a number called, which consists partly of a whole number and partly of a decimal?

In what manner do whole numbers increase, and in what manner do decimals decrease in value?

What do you observe by the inspection of the table?

What is to be noted with respect to placing ciphers after decimal figures?

What is to be noted with respect to placing ciphers between the decimal point and any other figure?

ADDITION OF DECIMALS.

Rule.

Set down the given numbers under each other; observing to place tenths under tenths, hundredths under hundredths, &c.; and perform the operation in the same manner as addition of whole numbers.

Note that all the decimal points stand exactly under each other, and that the decimal point in the product stands exactly under those in the example.

Questions.

How are decimal numbers, given to be added, to be set down; and how is the operation then to be performed?

What is to be noted with respect to placing the decimal point in the sum, and in the sum total?

Examples.

3.71	36.12	.4	21.7
.23	4.122	.91	6.12
.40	.04	.385	14.635
5.863	5.263	.51	.803
51.25	1.027	.832	4.007
.61	.214	.16	364.483
62.063	46.786	3.197	411.748

5. Add 56.12, .7, 1.314, 5837.01, and .15, together.
Ans. 5895.294.

6. Add 361.04, .120, 78.0006, 101.54, 8.943, and .3 together. *Ans.* 549.9436.

MULTIPLICATION OF DECIMALS.

Rule.

Set down the multiplier under the multiplicand, as in simple multiplication; and multiply without any regard to the decimal points.

When the operation of multiplying is completed, commence at the right-hand figure of the product, and count off as many figures towards the left as there are decimal figures in the multiplier and multiplicand, and there place the decimal point.

Note.—If the number of figures in the product is not so great as the number of decimal figures in both the multiplier and multiplicand, a sufficient number of ciphers must be placed to the left of the product, to make the figures in the product equal to the decimals in both factors, and the decimal point must then be placed to the left of the ciphers.

Questions.

How do you place the multiplier and multiplicand in multiplication of decimals?

When the operation of multiplying is completed, how do you proceed to find where the decimal point is to be placed?

What is to be noted, when the number of figures in the product is not equal to the number of figures in both factors?

Examples.

```
1. Multiply  .322 by 6.12
             6.12
             ----
              644
             322
            1932
            -------
            1.97064  Ans.
```

2. Multiply 54.20 by 38.63. *Ans.* 2093.7460.
3. Multiply 4560. by .3720. *Ans.* 1696.3200.
4. Multiply .28043 by .0005. *Ans.* .000140215.

SUBTRACTION OF DECIMALS.

Rule.

Place the less number under the greater, as in simple subtraction; observing that the decimal points stand exactly under each other: then subtract as in simple subtraction; taking care to place the decimal point in the remainder exactly under those in the example.

Questions.

How do you place the numbers in subtraction of decimals?

What is to be observed with respect to placing the decimal point in the remainder?

Examples.

.7613	42.183	.3758	86394.12
.4260	6.214	.284	281.421
.3353	35.969	.0918	86112.699

5. Subtract 4.286 from 13.16421. *Ans.* 8.87821.
6. From 5960. take .3742. *Ans.* 5959.6258.

DIVISION OF DECIMALS.

Rule.

1. Set down the divisor and dividend, as in whole numbers, and divide without any regard to the decimal points.

2. When the operation of dividing is completed, point off from the right of the quotients as many figures as the decimal figures in the dividend exceed those in the divisor, and there fix the decimal point.

Note.—If there should not be as many figures in the quotient, as the decimal figures in the dividend exceed those in the divisor, place as many ciphers to the left of the quotient as will make up the number, and place the decimal point to the left.

Note 2.—If the dividend should be less than the divisor, annex ciphers until it will contain the divisor, and fix the decimal point in the quotient accordingly.

Note 3.—If there be a remainder, annex ciphers to it, and proceed in the same manner as though the ciphers had been placed to the right of the dividend before commencing the operation.

Questions.

What is first to be done, when you commence an operation in division of decimals?

When the operation of dividing is completed, how do you find where the decimal point ought to be placed?

If there should not be as many figures in the quotient as the decimal figures exceed those in the divisor, what is to be done?

If the dividend be less than the divisor, what is to be done?

If there be a remainder, how do you proceed with it?

Examples.

1. Divide 42.665 by 33.5.

33.5)42.665(1.27 *Ans.*
33.5
916
670
2465
2345
120 remainder.

2. Divide 148.63 by 4.21. *Ans.* 35.304.+
3. Divide .2142 by 3.2. *Ans.* .066.+
4. Divide 2.00385 by 931. *Ans.* .0021523.

REDUCTION OF DECIMALS.

Case 1.

To reduce a vulgar fraction to a decimal.

Rule.

Place ciphers to the right of the numerator, until you can divide it by the denominator, and continue to divide until there is no remainder left; or if it be a number which will never come out without a remainder, until it is carried out to a convenient number of decimal places.

Note.—There must be as many places in the quotient as there have been ciphers annexed to the dividend.

Case 2.

To reduce any given sum or quantity to the decimal of any higher given denomination.

Rule.

1. Reduce the given sum or quantity to the lowest denomination mentioned in it.
2. Reduce one of that denomination of which you wish to make it a decimal, to the same denomination with the given sum.
3. Divide the given quantity so reduced by one of the denomination of which you wish to make it a decimal; the quotient will be the decimal required.

Case 3.

To reduce a decimal fraction to its proper value.

Rule.

Multiply the given fraction continually by the denomination next lower than that of which it is a decimal, for the proper value.

Questions.

How do you reduce a vulgar fraction to a decimal?

What is to be noticed, respecting the number of decimal places in the quotient?

How do you reduce any given sum or quantity to the decimal of any given denomination?

How do you reduce a decimal fraction to its proper value?

Case 1.

1. Reduce $\frac{4}{5}$ to a decimal.

$$\begin{array}{r} 5)40 \\ \hline .8 \end{array}$$ *Ans.*

2. Reduce $\frac{7}{8}$ to a decimal. *Ans.* .87
3. Reduce $\frac{17}{24}$ to a decimal. *Ans.* .70833.+
4. Reduce $\frac{381}{2162}$ to a decimal. *Ans.* .1762 +
5. Reduce $\frac{116}{254}$ to a decimal. *Ans.* .4566.+

Case 2.

1. Reduce 3*s*. 6*d*. to the decimal of a pound.

3*s*. 6*d*.= 42 240)42.000(.175 decimals. *An*
£1 =240

$$\begin{array}{r} 240 \\ \hline 1800 \\ 1680 \\ \hline 1200 \\ 1200 \\ \hline \end{array}$$

2. Reduce 2*R*. 4*P*. to the decimal of an acre. *Ans*. .525.
3. Reduce 2 qr. 2 nails to the decimal of a yard. *Ans*. .625.
4. Reduce 5 minutes to the decimal of an hour. *Ans*. .08333.
5. Reduce 10 grains to the decimal of an ounce, apothecaries' weight. *Ans*. .02083.+
6. Reduce 2 quarts 1 pint to the decimal of a hogshead. *Ans*. .00992.+

Case 3.

1. What is the value of .375 of a dollar? *Ans.* 37½*cts.*

```
.375
  100
-----
37.500
    10
------
 5.000
```

2. What is the value of .1361 of a £.? *Ans.* 2*s.* 8½*d.*
3. What is the value of .235 of a day? *Ans.* 5 *hours* 38*min.* 24*sec.*
4. What is the value of .42 of a gallon? *Ans.* 1*qt.* 1.36*pt.*
5. What is the value of .253 of a shilling? *Ans.* 3.036*d.*
6. What is the value of .436 of a yard? *Ans.* 1*qr.* 2.976*na.*
7. What is the value of .9 of an acre? *Ans.* 3*R.* 24*P.*

RULE OF THREE IN DECIMALS.

Rule.

State the question as the rule of three in whole numbers, only observe, when you multiply and divide, to place the decimal points according to the rules of multiplication and division of decimals.

Question.

How do you perform operations in the rule of three in decimals?

Examples.

1. If 4.2*lb.* of coffee cost 8*s.* 2.3*d.*, what cost 639.25*lb.*?

lb. *lb.* *s. d.* *£ s. d.*
4.2 : 639.25 : : 8 2.3 : 62 6 9.49 *Ans.*

2. When 1.4 yard cost 13*s.*, what will 15 yards come to, at the same price? *Ans.* £6 19*s.* 3*d.* 1.71*qr.*

3. If I sell 1 qr. of cloth for 2 dollars 34.5 cents, what is it per yard? *Ans.* $9 38*cts.*

4. A merchant sold 10.5 cwt. of sugar, for 108.30 dollars; for which he paid 84 dollars 39.12 cents: what did he gain per cwt. by the sale? *Ans.* $2 27*cts.* 7*m.*+

5. How many pieces of cloth, at 20.8 dollars per piece, are equal in value to 240 pieces, at 12.6 dollars per piece? *Ans.* 145.38+ *pieces.*

6. If, when the price of wheat is 74.6 cents per bushel, the penny roll weighs 5.2 oz., what should it be per bushel when the penny roll weighs 3.5 oz.? *Ans.* $1 10*cts.* 8*m.*+

POSITION.

By this rule, we are able to discover true numbers, by working with supposed ones as though they were real.

Position is of two kinds, Single and Double.

Single Position is when it is necessary to make use of only one supposed number; Double Position is when it is necessary to make use of two supposed numbers.

SINGLE POSITION.

Rule.

1. Suppose a number, and work with it as though it was the real one, and observe the result.—Then,

2. As the result of that operation,
Is to the supposed number,
So is the number given,
To the number required.

DOUBLE POSITION.

Rule.

1. Suppose a number, and work with it as directed in the question, as though it were a real number, until you obtain the result, which will be the error.

2. Suppose some other number, and proceed in the same way to find a second result or error.

3. Multiply the first result or error by the second supposed number, and the second result or error by the first supposed number.

4. Observe whether the errors are both of the same kind; *i. e.* both too great, or both too little.

5. If the errors are alike, divide the difference of the products by the difference of the errors, and the product will be the true number or answer.

But if the errors are one too great and the other too little, divide the sum of the products by the sum of the errors, and the product will be the true number or answer.

Questions.

What is Position?

How many kinds of Position are there?

When is Single Position used?

When is Double Position used?

What is first to be done, when you commence an operation by Single Position?

After having ascertained the result of the operation, how do you proceed?

How do you first proceed, when commencing an operation in Double Position?

After having obtained the first error, how do you proceed?

When you have obtained the second error, what is then to be done?

What have you to consider, after you have multiplied the second supposition by the first error, and the first supposition by the second error?

When you have observed whether the errors are both of the same kind, how do you proceed, if they are both of the same kind?

But if they are not both of the same kind, how do you proceed?

SINGLE POSITION.

Examples.

1. A gentleman having received a number of coins,

says, $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{10}$ of the number is 87: what number of coins was there?

Suppose he had 180	174 : 180 :: 87	Proof
	87	90
$\frac{1}{2}$ 90		
$\frac{1}{5}$ 36	1260	$\frac{1}{2}$ 45
$\frac{1}{6}$ 30	1440	$\frac{1}{5}$ 18
$\frac{1}{10}$ 18		$\frac{1}{6}$ 15
	174)15660(90 *Ans.*	$\frac{1}{10}$ 9
174	1566	
		87
	0	

2. A certain box contains a number of dollars, $\frac{1}{3}$, $\frac{1}{6}$, and $\frac{1}{12}$ of which is 690: how many was in the box? *Ans.* 1200.

3. The ages of A., B., and C. amount to 133 years; B. is $\frac{1}{5}$ older than C., and A. is $\frac{1}{3}$ older than B.: what are their separate ages? *Ans.* A. 56, B. 42, and C. 35*yr.*

4. A person bought 3 pipes of wine for 350 dollars; No. 1 cost double the sum that No. 2 did, and No. 2, three times the price that No. 3 did: what was the price of each? *Ans.* No. 1, \$210; No. 2, \$105; No. 3, \$35.

5. A gentleman being asked his age, replied, if the years of my life were doubled, and three-fifths of the product divided by 3, the result would be 14: what was his age? *Ans.* 35 *years.*

6. A person lent a sum of money at 5$\frac{3}{4}$ per cent. simple interest, and at the expiration of 4 years and 8 months he received for interest £201 5*s.*: what was the sum lent? *Ans.* £750.

7. A cistern has two cocks to supply it with water; by the first it may be filled in 45 minutes, and by the second in 55 minutes; it has likewise a discharging cock, by which it may, when full, be emptied in 30 minutes: if these 3 cocks be left open, in what time will the cistern be filled? *Ans.* 2*h.* 21*m.* 25$\frac{5}{7}$*sec.*

DOUBLE POSITION.

1. Bought cloth for a cloak, at 6 dollars per yard, a

baize to line it at 1 dollar; the number of yards was 12, and the cost 42 dollars: how many yards were there of each?

First, suppose there were
8 yards of cloth, at $6=48
4 yards of baize, at 1= 4
—
52
42
—
10 error too much.

Again, suppose there were
7 yards of cloth, at $6=42
5 yards of baize, at 1= 5
—
47
42
—
5 error too much.

10×7=70
5×8=40
— —
diff. of error 5 5)30
—
Ans. 6 yards of each.

Proof: 6 yards of cloth, at $6=36
12—6=6 yards of baize, at 1= 6
—
42 proof.

2. A. and B. receive the same salary: A. saves one-third of his every year, but B., by spending 250 dollars per annum more than A., finds at the expiration of 7 years that he is 350 dollars in debt: what is their income, and what does each spend per annum?

Ans. Their income, $600.
A. spends 400.
B. spends 650.

3. A labourer engaged himself for 50 days, on condition that for every day he worked he should receive 1 dollar, but for every day that he was idle he should for-

feit 50 cents: at the expiration of the time he received 27 dollars 50 cents: how many days did he work, and how many was he idle? *Ans.* worked 35, idle 15 *days.*

4. A farmer having driven his cattle to market, received for them all 320 dollars; being paid at the rate of 24 dollars per ox, 16 dollars per cow, and 6 dollars per calf; there were as many oxen as cows, and four times as many calves as cows: how many were there of each?
Ans. 5 *oxen*, 5 *cows*, 20 *calves.*

5. There is a pole divided into 3 parts; No. 1 is 15 feet long; No. 3 is as long as No. 1 and half of No. 2; No. 2 is as long as Nos. 1 and 3 together: what is the length of the pole, and what the length of each part?
Ans. Pole, 120 *feet;* No. 1, 15 *feet;* No. 2, 60 *feet;* and No. 3, 45 *feet.*

6. A father left his property to his three sons, A., B., and C., dividing in the following manner: to A. he gave half, wanting £40; to B., one-third and £12; to C., the remainder, which was £80 less than B.'s share: what was the amount of property, and what was each share separate? *Ans.* The whole amount, £576; A.'s share, £248; B.'s share, £204; C.'s share, £124.

7. The sum of £172 19*s.* 4¼*d.* is to be divided among 7 men, 11 women, and 19 boys, in such a manner, that each woman will have but one-third as much as a man, and twice as much as a boy: what is the sum of each?
Ans. Each man, £12 10*s.* 0¾*d.*+; each woman, £4 3*s.* 4¼*d.*+; each boy, £2 1*s.* 8*d.*+

INVOLUTION, OR THE RAISING OF POWERS.

The product arising from any number multiplied by itself, any number of times, is called its power, as follows:

$2\times2=4$ the square, or 2d power of 2.

$2\times2\times2=8$ 3d power or cube of 2.

$2\times2\times2\times2=16$ 4th power of 2.

The number which denotes a power is called its index.

Note.—When any power of a vulgar fraction is required, first raise the numerator to the required power, and then the denominator to the required power, and place the numerator over the denominator as before: thus, the 4th power of $\frac{2}{3}$ $\frac{2\times2\times2\times2}{3\times3\times3\times3}=\frac{16}{81}$.

Table of the first nine Powers.

Roots.	*Squares.*	*Cubes.*	*4th power.*	*5th power.*	*6th power.*	*7th power.*	*8th power.*	*9th power.*
1	1	1	1	1	1		1	1
2	4	8	16	32	64	128	256	512
3	9	27	81	243	629	2187	6564	1968
4	16	64	256	1024	4006	16384	65536	262144
5	25	125	625	3125	15625	78125	390625	1953125
6	36	216	1296	7776	46656	279936	1679616	1007769
7	49	343	2401	16807	117649	823543	5764801	4035360
8	64	512	4096	32768	262144	2097152	16777216	13421772
9	81	729	6561	59049	531441	4782962	43046721	387420489

Questions.

What is the product arising from the multiplication of any figure by itself a given number of times, called?

What is the number which denotes a power called?

How do you proceed to find any required power of a vulgar fraction?

Examples.

1. What is the square of 32?

$$\begin{array}{r} 32 \\ \hline 64 \\ 96 \\ \hline 1024 \end{array}$$ *Ans.*

2. What is the cube of 14? *Ans.* 2744.
3. What is the sixth power of 2.8? *Ans.* 481.890304.
4. What is the third power of .263? *Ans.* .018191447.
5. What is the eighth power of $\frac{1}{4}$? *Ans.* $\frac{1}{65536}$.
6. What is the fourth power of 401? *Ans.* 25856961601.

EVOLUTION, OR THE EXTRACTING OF ROOTS.

The Root of a number is that which will produce that number, by being multiplied by itself a given number of times. The object proposed by the extraction of the root of a number, is to find that number which, being multiplied by itself a number of times equal to that for which the root is required, will produce that number.

SQUARE ROOT.

When the square root of any given number is required.

1. Separate the given number into periods of two figures each, beginning at the right hand or unit's place.

Note.—If the square root of a whole number and decimal is required, point the whole numbers as before, and then commence at the decimal point, and count periods of two figures each towards the right; observing, if there is only one figure at the last, to place a cipher to its right, to make an even period. When a decimal only is given, separate the periods in the same way.

2. Find the greatest root of the first left-hand period, and place it to the right of the given sum, and its square under said period, and take their difference.

3. Bring down the next period, and set it to the right of the remainder, as in long division, for a dividend.

4. After bringing down the period, double the ascertained root, and place it to the left of the remainder, for a divisor.

5. Try how often the divisor is contained in the dividend, omitting the last figure, and place the result to the right of the ascertained root, and to the right of the number produced by doubling the ascertained root.

6. Multiply as in long division, and proceed with the operation until all the periods have been brought down.

Note.—When the square root of a fraction is required, extract the square root of the numerator, for a new numerator, and square root of the denominator, for a new denominator. If there be a remainder, either to the numerator or denominator, reduce the fraction to a decimal, and extract the square root.

Questions.

When the square root of any given number is required, how do you prepare the given sum?

What is to be noted, when whole numbers and decimals, and decimals only, are given?

After separating the given number into periods of two figures, what is to be done?

After having found the greatest root of the first left-hand period, and placed it to the right of the given sum, and its square under the first period, and taken their difference, what is to be done?

When you have brought down the next period, and placed it to the right of the remainder for a dividend, how do you proceed?

When you have doubled the ascertained root, and placed it to the right of the divisor, what is to be done?

When you have found how often double the ascertained root is contained in the dividend, with one figure omitted, what is next to be done, and how do you proceed till the operation is completed?

What is to be noted, when the square root of a vulgar fraction is required?

Examples.

1. What is the square root of 6.9169?

6.9169(2.63 *Ans.*
4

46)291
276

523)1569
1569

2. What is the square root of 39375655? *Ans.* 6275.+

3. What is the square root of 1486.17901?
Ans. 38.55.+

4. What is the square root of 96385163? *Ans.* 9817.+

5. What is the square root of .000132496?
Ans. .01151.+

6. What is the square root of 18.362147?
Ans. 4.285.+

7. What is the square root of $\frac{2450}{3200}$? *Ans.*

8. What is the square root of $\frac{1296}{1764}$? *Ans.*

9. What is the square root of $\frac{320}{500}$? *Ans.*

10. What is the square root of $50\frac{49}{64}$? *Ans.*

11. What is the square root of $30\frac{25}{100}$? *Ans.* 5

12. An employer paid 1296 dollars to a number of m and each man received as many dollars as there w men: how many men were there? *Ans.* 36 men.

13. Supposing a polygonal tower had on each side equal number of windows, and that the whole numb was 169; the number of windows in each side, bei equal to the number of sides, it is required to find ho many windows were in each side? *Ans.* 13.

14. A certain square piece of land contains 3097 square yards: the length of one of its sides is required.
Ans. 1 mile.

Note.—The square of the longest side of the right-angled angle is equal to the sum of the squares of the other two side and consequently the difference of the square of the longest, and either of the others, is the square of the remaining one.

15. If the height of a fort be 15 feet, and surrounded by a ditch 24 feet wide, what must be the length of a ladder to reach from the outside of the ditch to the top of the fort? *Ans.* 28.3+ *feet.*

16. What is the height of a castle, when a line 212 feet long will just reach from the top of the castle to the opposite bank of a river, known to be 20 yards broad? *Ans.* 203.332+ *feet.*

CUBE ROOT.

When the cube root of any number is required.

1. Prepare the given number, by separating it into periods of three figures each from the units' place.

Note.—When whole numbers and decimals, or decimals only, are given, the same observation is to be made, as to the manner of separating the figures into periods, as in the square root.

2. Find the greatest root contained in the left-hand period; place it to the right of the given number, and its cube under the first left-hand period, and take their difference; bring down the next period, and place it to the right of said difference for a dividend.

3. Square the root, and multiply the square by 3, for a defective divisor.

4. Try how often the defective divisor is contained in the dividend, omitting the two right-hand figures, and place the number of times it is contained to the right of the ascertained root, and its square to the right of the defective divisor, supplying the place of tens with a cipher, if the square be less than 10.

5. Multiply the last figure by all the figures of the root previously ascertained, and multiply that product by 30; then add the product to the divisor to complete it.

Multiply and subtract as in long division, and bring lown the next period for a new dividend continually, until all the periods have been brought down.

Note.—When the cube root of a vulgar fraction is required, reduce it to its lowest terms, and extract the cube root of the numerator for a new numerator, and the cube root of the denominator for a new denominator; when the numerator and denominator, or both, have remainders, reduce the fraction to a decimal, and extract the cube root.

2. When a mixed number is given, reduce the fraction to a decimal, and extract the cube root.

Questions.

How do you prepare a given sum for the extraction of the cube root?

What is to be noted, when a whole number and decimal, or decimal only, is given?

What is next to be done, after dividing the given number into periods of three figures?

When you have found the greatest root contained in the left-hand period, and placed its cube under the first period, what is to be done next?

How do you proceed, after having squared the ascertained root, and multiplied it by 3?

When you have tried how often the defective divisor is contained in the dividend, omitting the left-hand period, &c., what is to be done next?

When you have multiplied the last figure by all the figures of the ascertained root, and by 30, what is next to be done?

When the cube root of a vulgar fraction is required, how do you find it?

When the cube root of a mixed number is required, how do you find it?

Examples.

1. What is the cube root of 3796416?

3796416(156 *Ans.*
1

Defective div. and square of 5, 325)2796
+150=complete divisor, 475 3275

Defective div. and square of 6, 67536)421416
+2700=complete divisor, 70236 421416

2. What is the cube root of 7532641? *Ans.* 196.02.+
3. What is the cube root of 12.1138475? *Ans.* 2.296.+
4. What is the cube root of 5382674? *Ans.* 175.2.+
5. What is the cube root of .37862135? *Ans.* .723.+
6. What is the cube root of 46.295363543? *Ans.* 3.590.+
7. What is the cube root of $\frac{208}{1036}$? *Ans.* .585.+
8. What is the cube root of $36\frac{26}{30}$? *Ans.* 3.32.+

◆

ALLIGATION.

ALLIGATION is a rule which enables us to resolve questions concerning the mixture of several simples into one compound quantity.

Case 1.

When the quantity and rates of the simples are given, to find the rate of a mixture compounded of these simples.

Rule.

1. Find the value of each quantity according to their respective costs.

2. As the whole of the quantities
Is to one of its parts,
So is the total amount of their value
To the value of one of its parts.

Case 2.

When the prices of several simples are given to find how much of each, at their respective rates, will be required to make a mixture at any proposed price.

Rule.

1. Place all the rates of the simples under each other, and link each rate which is less than the mean rate, with one or more that is greater.

2. Take the difference between each rate, and the mean price placed opposite the respective rate with which it is linked, which will be the quantity required.

Note.—If all the given prices are greater or less than the mean price, they must be linked to a cipher. Different modes of linking produce different answers.

Case 3.

When the prices of all the simples, the quantity of one of them, and the mean price of the whole mixture, are given to find the quantities of the rest.

Rule.

1. Place the mean rate and the several prices; link them, and take their differences, as in the preceding case.

2. As the difference of the same name with the quantity given,
Is to the differences respectively,
So is the given quantity
To the several required quantities.

Case 4.

When the prices of the several simples, the quantity to be compounded, and the mean price, are given to find the quantity of each simple.

Rule.

1. Link the several prices, and take their differences, as before.

2. As the sum of the differences
Is to the difference opposite each price,
So is the quantity to be compounded
To the quantity required.

Questions.

What is Alligation?

When the quantities and the rates of the simples are given to find the rate of a mixture compounded of these simples, how do you work?

By what rule do you work, when the price of several simples is given to find how much of each, at their respective rates, will be required to make a mixture at any proposed price?

How do you proceed, when the price of all the simples, the quantity of one of them, and the mean price of the whole, are given to find the quantities of the rest?

How do you proceed, when the prices of the several simples, the quantity to be compounded, and the mean price, are given to find the quantity of each simple?

Case 1.

1. If a person have 4 lb. of tea, at 90 cents per lb., 8 lb. at 75 cents, and 6 lb. at 110 cents, to be mixed together, what will a pound of the mixture be worth?

lb.		*cts.*		*cts.*
4	at	90	=	360
8	at	75	=	600
6	at	110	=	660
18				1620

As 18 : 1 : : 1620 : 90*cts.* *Ans.*

2. A grocer has 2 cwt. of coffee, at 25 dollars per cwt., 4 cwt. at 20 dollars 50 cents per cwt., and 7 cwt. at 18 dollars 62½ cents per cwt., which he will mix together: what will 1 cwt. of this mixture be worth?

Ans. $20 18¼*cts.*

Case 2.

1. What quantity of sugar, at 11*cts.* per lb., at 6*cts.* pe lb., and at 8*cts.* per lb., will make a mixture worth 7*cts.* per lb.? *Ans.* 1*lb.* at 11*cts.*, 1*lb.* at 8*cts.*, and 5*lb.* at 6*cts.*

$$\text{Mean rate } 7\left\{\begin{array}{l}6\\8\\11\end{array}\right. \begin{array}{lrlr}1+4=5 & & \text{at} & 6\\ 1 & 1 & \text{at} & 8\\ 1 & 1 & \text{at} & 11\end{array}$$

2. How much wheat, at 110 cents per bushel, rye, 86 cents per bushel, oats, at 34 cents per bushel, and ba ley, at 42 cents per bushel, will it take to make a composition worth 50 cents per bushel? *Ans.* 8*bu.* at 110*cts.*, 16*bu.* at 86*cts.*, 60*bu.* at 42*cts.*, 36*bu.* at 34*cts.*

Case 3.

1. What quantity of coffee, at 20 cents, and at 16 cent per lb., must be mixed with 35 lb. at 14 cents, to make mixture worth 18 cents per lb.?

$$\text{Mean rate } 18\left\{\begin{array}{l}14\\16\\20\end{array}\right. \begin{array}{rl}2 & \text{Then as } 2:35::2:\ 35 \text{ at}\\ 2 & \qquad\quad 2:35::6:105 \text{ at}\\ 4+2=6 & \end{array}$$

2. How much tea, at 86 cents, at 94 cents, and at cents per lb. ought to be mixed with 6 lb. at 75 cents lb., for a mixture, to sell at 92 cents per lb.?

Ans. 18*lb.* at 105*cts.*, 51*lb.* at 94*cts.*, 39*lb.* at 86*cts.*

Case 4.

1. A grocer has 3 sorts of sugar, viz. 10*cts.*, 11*cts.*, 8*cts.* per lb., and he would have a composition of 40 lb worth 9*cts.* per lb.: how much of each sort must he take

$$\text{Mean rate } 9\left\{\begin{array}{l}8\\10\\11\end{array}\right. \begin{array}{lr}1+2= & 3\\ 1 & 1\\ 1 & \underline{1}\end{array}$$

Sum of differences 5

$$\textit{Ans.}\left\{\begin{array}{l}5:3::40:24 \text{ at } 8\\ 5:1::40:\ \ 8 \text{ at } 10\\ 5:1::40:\ \ 8 \text{ at } 11\end{array}\right.$$

2. A vintner has wine at 130 cents, at 160 cents, at 180 cents per gallon; and he would have 32 worth 145 cents per gallon: I demand how much of sort he must have?

Ans. 20*gal.* at 130*cts.*, 6*gal.* at 160*cts.*, and 6*gal.* at 180*cts.*

ARITHMETICAL PROGRESSION.

Arithmetical Progression is a series of numbers, which increase or decrease by a continual addition or subtraction of the same numbers; as, 1, 2, 3, 4, 5, 6; 1, 3, 5, 7, 9, 11; 6, 5, 4, 3, 2, 1; 11, 9, 7, 5, 3, 1.

There are five things to be particularly attended to in Arithmetical Progression; the first term, the last term, the number of terms, the common difference, and the sum of all the terms.

Case 1.

The first term, common difference, and number of terms, being given, to find the last term, and sum of all the terms.

Rule.

1. Multiply the number of terms, less 1, by the common difference, and to that product add the first term; the sum is the last term.
2. Add the first and last terms together, and multiply the sum by the number of terms; and half the product will be the sum of all the terms.

Case 2.

When the first and last terms (or two extremes,) are given to find the common difference.

Rule.

Divide the difference of the extremes by the number of terms, less 1; the quotient will be the common difference.

Questions.

What is Arithmetical Progression?

Name the five things which should be particularly attended to in Arithmetical Progression.

By what rule do you work, when the first term, common difference, and number of terms, are given to find the last term, and sum of all the terms?

By what rule do you work, when the first and la terms are given to find the common difference?

Examples.

1. What is the last term, and the sum of all the ter of an Arithmetical Progression, whose first term is 1, th common difference 2, and number of terms 19?

19—1=18
2
—
36
+1
—
The last term 37

1+37=38
19
—
342
38
—
2)722
—
Sum of all the terms 361 *Ans.*

2. A person sold 40 yards of linen, at 2 cents for th first yard, 4 cents for the second, increasing 2 cents eve yard: what did they amount to? *Ans.* $16.40.

3. A man, on a journey, travels the first day 10 mile the second 14 miles, increasing 4 miles every day: ho many miles did he travel the 10th day, and how ma miles did he travel in all?

Ans. 46 *miles*, 10th day; travelled in all, 280 *miles.*

4. A butcher bought 75 sheep, and gave 6 cents for th first, 8 for the second, &c.: what did he give for the la and what did the whole number cost him?

Ans. For the last, $1.54; the whole, $60.00.

Case 2.

1. If the ages of 12 persons are equally different, th youngest is 18 years, and the eldest 40, what is the com mon difference of their ages?

40
18
—
12—1=11)22(2 common difference.
22
—

2. When a debt is paid at 8 different payment Arithmetical Progression, the first payment to be $1

lars, the last 175 dollars: what is the common difference, and what each payment, and what was the whole debt?

Ans. Common difference, $22; 2d payment, $43, 3d payment, $65, &c.; whole sum, $784.

3. A man received charity from 10 different persons; the first gave him 4 cents, the last 49 cents, in Arithmetical Progression: what was the common difference, and what did the man receive?

Ans. Received, $2.65; common difference, 5*cts.*

GEOMETRICAL PROGRESSION.

GEOMETRICAL PROGRESSION is the increase of a series of numbers by a common multiplier, or decrease by a common divisor; as, 2, 4, 8, 16, 32; 32, 16, 8, 4, 2.

The ratio is the number by which the series increases or decreases.

To find the last term, and sum of the series.

Rule.

1. Raise the ratio to the power whose index is one less than the number of terms given.
2. Multiply the product by the first term, and that product will be the last term.
3. Multiply the last term by the ratio; from the product subtract the first term, and divide the remainder by the ratio, less 1, for the sum of the series.

Questions.

What is Geometrical Progression?

What is the ratio?

By what rule do you proceed to find the last term, and sum of all the series?

Examples.

1. If I buy 16 cords of wood, and agree to pay 2 cents for the first, 4 cents for the second, 8 for the third, &c., doubling the price to the last, what will it cost me?

Power, 1. 2. 3. 4. Ratio, 2 4 8 16
16
96
16
256 8th power.
16 4th power.
1536
256
4096 12th power.
8 3d power
32768 15th power.
2 1st term.
65536 last term.
2 ratio.
131072
2 1st term.
Ratio 2—1=1)131070
Sum of series $1310.70 *Ans.*

2. A person dying left 8 children, to whom he bequeat in the following manner; viz. the youngest child to have £5, the next youngest £15, and so on, every child to exceed t next younger in triple proportion: what will be the sha of the eldest, and what the whole sum left? *Ans.* Sha of eldest son, £10935; whole sum left, £16400.

3. A person, at the birth of his son, deposited in ba 1 cent towards his portion, promising to double it at th return of every birthday, until he was 21 years of ag what was his portion? *Ans.* $20971 51*cts.*

* * *

COMPOUND INTEREST BY DECIMALS.

The ratio in Compound Interest is the amount of 1 dollar or pound for 1 year, which is found as follows:

As 100 : 1 :: 106 : 1.06

Note 1.—The 4th root of the ratio will be the quarterly amount; the square root, the half-yearly amount; and the product arising from the half-yearly and quarter-yearly, multiplied together, the three-quarter-yearly amount; as follows:

Thus: $\sqrt[4]{1.06}=1.014674$ quarterly amount. And $\sqrt[2]{1.06}=1.029536$ half-yearly amount. Then. $1.014674\times1.029536=1.044671$, amount for 3 qrs. of a year, at 6 per cent.

Note 2.—The 4th root is found by extracting the square root of the square root.

The ratio involved to the power whose index is the time, is the amount of 1 dollar or pound for that time; as, a square for 2 years, a cube for 3 years, &c.

$1.06\times1.06\times1.06=1.1910160$, amount of 1 pound or dollar for 3 years, at 6 per cent.

When the ratio is to be involved to years and quarters, the power for the years must be multiplied by the quarterly amount. Thus: $1.1910160\times1.014674=1.2184929$, amount for $3\frac{1}{4}$ years at 6 per cent.

The power of 1 dollar or pound may also be obtained for months and days, nearly, by adding the monthly simple interest of 1 pound or dollar, or proper parts thereof, to the amount of the quarter next preceding the given time for what that time exceeds the said quarter, as follows:

Amt. for $\frac{1}{2}$ year.	1.029563	for $4\frac{3}{4}$ years	1.311873
Int. of $1, for 1 mo.	.005000	for 1 month	.005000
$\frac{1}{6}$ for 5 days	.000833	$\frac{1}{6}$ for 5 days	.000833
for 7 mo. 5 days	1.034396	Amt. for 4*Y.* 10*m.* 5*d.*	1.324706

TABLE I.

Amount of 1l. or dollar for a year, and for quarters, at Compound Interest

Rate per cent.	Ratio.	For 3 quarters.	For 2 quarters.	For 1 quarter.	Simple Interest of 1*l.* for 1 month.
3	1.03	1.022416	1.014889	1.007417	.002500
$3\frac{1}{2}$	1.035	1.026173	1.017349	1.008637	.002917
4	1.04	1.029852	1.019804	1.009853	.003333
$4\frac{1}{2}$	1.045	1.033563	1.022252	1.011065	.003750
5	1.05	1.037270	1.024695	1.012272	.004167
$5\frac{1}{2}$	1.055	1.040973	1.027132	1.013475	.004583
6	1.06	1.044671	1.029536	1.014674	.005000
$6\frac{1}{2}$	1.065	1.048364	1.031988	1.015868	.005417
7	1.07	1.052053	1.034408	1.017058	.005833

TABLE II.

Showing the amount of £1 or $1, from 1 year to 46.

yr.	3½ per cent.	4 per cent.	4½ per cent.	5 per cent.	5½ per cent.	6 per cent.
1	1.0350000	1.0400000	1.0450000	1.0500000	1.0550000	1.0600000
2	1.0712250	1.0816000	1.0920250	1.1025000	1.1130250	1.1236000
3	1.1087178	1.1248640	1.1411661	1.1576250	1.1742413	1.1910160
4	1.1475230	1.1698585	1.1925186	1.2155062	1.2388246	1.2624769
5	1.1876863	1.2166529	1.2461819	1.2762815	1.3069598	1.3312256
6	1.2292553	1.2653190	1.3022601	1.3400956	1.3788426	1.4185191
7	1.2722792	1.3159317	1.3608618	1.4071004	1.4546789	1.5030302
8	1.3168093	1.3685690	1.4221006	1.4774554	1.5346862	1.5938480
9	1.3621973	1.4233118	1.4860951	1.5513282	1.6190939	1.6894789
10	1.4105987	1.4802442	1.5529694	1.6288946	1.7081440	1.7908476
11	1.4599697	1.5394540	1.6228530	1.7103393	1.8020919	1.8982985
12	1.5110686	1.6010322	1.6958814	1.7958563	1.9012069	2.0121964
13	1.5630560	1.6650735	1.7721961	1.8856491	2.0057732	2.1329282
14	1.6186945	1.7316764	1.8519449	1.9799316	2.1160907	2.2609039
15	1.6753488	1.8009435	1.9362824	2.0789281	2.2324756	2.3965581
16	1.7339860	1.8729812	2.0223701	2.1828745	2.3552617	2.5403517
17	1.7946755	1.9479005	2.1133768	2.2920183	2.4848011	2.6927727
18	1.8574892	2.0258161	2.2084787	2.4066192	2.6214652	2.8543391
19	1.9225013	2.1068491	2.3078603	2.5269502	2.7656458	3.0255995
20	1.9897888	2.1911231	2.4117140	2.6532977	2.9177563	3.2071355
21	2.0594314	2.2787680	2.5202411	2.7859625	3.0782329	3.3995636
22	2.1315115	2.3699187	2.6336520	2.9252607	3.2475357	3.6035374
23	2.2061144	2.4647155	2.7521663	3.0715237	3.4261502	3.8097496
24	2.2833284	2.5633041	2.8760138	3.2250999	3.6145885	4.0489346
25	2.3632449	2.6658363	2.0054344	3.3863549	3.8133910	4.2918707
26	2.4459985	2.7724697	3.1406790	3.5556726	4.0231279	4.5493829
27	2.5315671	2.8833685	3.2820095	3.7334563	4.2443999	4.8223459
28	2.6201719	2.9987033	3.4296999	3.9231291	4.4778419	5.1116867
29	2.7118779	3.1186514	3.5840364	4.1161356	4.7241212	5.4183870
30	2.8067937	3.2433975	3.7453181	4.3219423	4.9839469	5.7434912
31	2.9050314	3.3731334	3.9138574	4.5380394	5.2580671	6.0881007
32	3.0067075	3.5080587	4.0899810	4.7649414	5.5472608	6.4533867
33	3.1119423	3.6481831	4.2740301	5.0031885	5.8523600	6.8405899
34	3.2208603	3.7943163	4.4663015	5.2533479	6.1742398	7.2510253
35	3.3335904	3.9460889	4.6673478	5.5160152	6.5138230	7.6860868
36	3.4502661	4.1030325	4.8773784	5.7918101	6.8720832	8.1472520
37	3.5710254	4.2680898	5.0968604	6.0814069	7.2500478	8.6360871
38	3.6960113	4.4388134	5.3262192	6.3854772	7.6488004	9.1542523
39	3.8253717	4.6163659	5.5658990	6.7047511	8.0694844	9.7035074
40	3.9592597	4.8010206	5.8163643	7.0399887	8.5133060	10.2867108
41	4.0978337	4.9930614	6.0781009	7.3919881	8.9815378	10.9028608
42	4.2412579	5.1927838	6.3514246	7.7615871	9.4755224	11.5570325
43	4.3897020	5.4004952	6.6375522	8.1496669	9.9966761	12.2504547
44	4.5433415	5.6165150	6.9362421	8.5571502	10.5464935	12.9854817
45	4.7023585	5.8411756	7.2483730	8.9850077	11.1265504	13.7646107
46	4.8669411	6.0748236	7.5745497	9.4342581	11.7385217	14.5904873

Questions.

What is the ratio in compound interest, and how is it obtained?

What is to be noticed, respecting three-quarterly, half-yearly, and quarterly amounts?

What is the amount of a dollar or pound for any given time?

What must be done, when the ratio is to be involved to years and quarters?

How may the power of a dollar or pound be obtained for years and days?

See TABLES III. and IV.

Case 1.

The principal, time, and rate, given to find the amount.

Rule.

Multiply the principal by the ratio involved to the time, which, for convenience, may be taken from Table II., and the product will be the amount; from which subtract the principal for the compound interest.

Case 2.

The amount, time, and rate per cent., given, to find the principal.

Rule.

Divide the amount by the ratio involved to the time.

Questions.

By what rule do you work in compound interest by decimals?

When the principal, time, and rate per cent., are given, to find the amount?

How do you proceed, when the amount, time, and rate per cent., are given, to find the principal?

TABLES TO FACILITATE THE CALCULATION OF ANNUITIES.

TABLE III.

Showing the amount of £1 annuity.

yr.	4 per cent.	4½ per cent.	5 per cent.	5½ per cent.	6 per cent.	yr.
1	1.	1.	1.	1.	1.	1
2	2.04	2.045	2.05	2.055	2.06	2
3	3.1216	3.137025	3.1525	3.168025	3.1836	3
4	4.246464	4.278191	4.310125	4.342266	4.374602	4
5	5.416322	5.470710	5.525631	5.581091	5.637093	5
6	6.632975	6.716892	6.801913	6.888051	6.975318	6
7	7.898294	8.019152	8.142008	8.266894	8.393837	7
8	9.214226	9.380014	9.549109	9.721573	9.897468	8
9	10.582795	10.802114	11.026564	11.256269	11.491316	9
10	12.006107	12.288210	12.577892	12.875354	13.180795	10
11	13.486351	13.841179	14.206787	14.583498	14.971643	11
12	15.025805	15.464032	15.917126	16.385590	16.869942	12
13	16.626838	17.159913	17.712983	18.286798	18.882138	13
14	18.291911	18.932109	19.598632	20.292572	21.015066	14
15	20.023588	20.784054	21.578563	22.408663	23.275971	15
16	21.824531	22.719337	23.657492	24.641140	25.672528	16
17	23.697512	24.741707	25.840366	26.996402	28.212881	17
18	25.645413	26.855084	28.132385	29.481205	30.905653	18
19	27.671229	29.063562	30.539004	32.102671	33.759993	19
20	29.778078	31.371423	33.065954	34.868318	36.785592	20
21	31.969202	33.783137	35.719252	37.786075	39.992728	21
22	34.247970	36.303378	38.505214	40.864309	43.392291	22
23	36.617888	38.937030	41.430475	44.111846	46.995828	23
24	39.082604	41.689196	44.501999	47.537998	50.815578	24
25	41.645908	44.565210	47.727099	51.152588	54.864513	25
26	44.311745	47.570645	51.113454	54.965979	59.156383	26
27	47.084214	50.711324	54.669126	58.989109	63.705766	27
28	49.967582	53.993333	58.402583	63.233510	68.528117	28
29	52.966286	57 423033	62.322712	67.711353	73.639798	29
30	56.084938	61.007069	66.438847	72.435478	79.058186	30
31	59.328335	64.752388	70.760790	77.419429	84.801677	31
32	62.701469	68.666245	75.298829	82.677498	90.889778	32
33	66.209527	72.756226	80.063771	88.224760	97.343165	33
34	69.857904	77.030256	85.066959	94.077122	104.183754	34
35	73.652225	81.496618	90.320307	100.251363	111.434780	35
36	77.598314	86.163966	95.836323	106.765188	119.120867	36
37	81.702246	91.041344	101.628139	113.637274	127.268118	37
38	85.970336	96.138205	107.709546	120.887324	135.904206	38
39	90.409150	101.464424	114.095023	128.536127	145.058458	39
40	95.025516	107.030323	120.799774	136.605146	154.761966	40

TABLE IV.

Showing the present worth of £1 annuity, for any number of years, from 1 to 40

yr.	4 per cent.	4½ per cent.	5 per cent.	5½ per cent.	6 per cent.	yr.
1	0.96154	0.95694	0.95231	0.94786	0.94339	1
2	1.88609	1.87267	1.85941	1.84632	1.83339	2
3	2.77509	2.74876	2.72325	2.69793	2.67301	3
4	3.62989	3.58752	3.54595	3.50514	3.46510	4
5	4.45182	4.38997	4.32948	4.27028	4.21236	5
6	5.24214	5.15787	5.07569	4.99553	4.91732	6
7	6.40205	5.89270	5.78637	5.68297	5.58238	7
8	6.73274	6.59589	6.46321	6.33457	6.20979	8
9	7.43533	7.26879	7.10782	6.95220	6.80169	9
10	8.11089	7.91272	7.72173	7.53762	7.36008	10
11	8.76048	8.52892	8.30640	8.06254	7.88687	11
12	9.38500	9.11858	8.86325	8.61852	8.38384	12
13	9.98565	9.68285	9.39357	9.11708	8.85268	13
14	10.56312	10.22282	9.89864	9.58965	9.29498	14
15	11.41839	10.73954	10.37965	10.03759	9.71225	15
16	11.65229	11.23401	10.83777	10.46216	9.10589	16
17	12.16567	11.70719	11.27407	10.86461	10.47726	17
18	12.65929	12.17999	11.68958	11.24607	10.82760	18
19	13.13394	12.59329	12.08532	11.60765	11.15811	19
20	13.59032	13.00793	12.46221	11.95034	11.46992	20
21	14.02916	13.40472	12.82115	12.27524	11.76407	21
22	14.45111	13.78442	13.16300	12.58317	12.04158	22
23	14.85684	14.14777	13.48857	12.87504	12.30338	23
24	15.24696	14.49548	13.79864	13.15170	12.55035	24
25	15.62208	14.82821	14.09394	13.41391	12.78335	25
26	15.98277	15.14661	14.37518	13.66250	13.00316	26
27	16.32959	15.45130	14.64303	13.89810	13.21053	27
28	16.66306	15.74287	14.89813	14.12142	13.40616	28
29	16.98371	16.02189	15.14107	14.33310	13.59072	29
30	17.29203	16.28889	15.37245	14.53375	13.76483	30
31	17.58849	16.54439	15.59281	14.72393	13.92908	31
32	17.87355	16.78889	15.80268	14.90420	14.08404	32
33	18.14764	17.02286	16.00255	15.07507	14.23023	33
34	18.41126	17.24676	16.19290	15.23703	14.36814	34
35	18.66461	17.46101	16.37414	15.39055	14.49825	35
36	18.90828	17.66604	16.54685	15.53607	14.62098	36
37	19.14258	17.86224	16.71129	15.67400	14.73678	37
38	19.36786	18.04999	16.86789	15.80474	14.84602	38
39	19.54448	18.22965	17.01704	15.92866	14.94907	39
40	19.79277	18.40158	17.15909	16.04612	14.92640	40

TABLE V.

Rate per cent.	Half-yearly payments.	Quarterly payments.
3	1.007445	1.011181
3½	1.008675	1.013031
4	1.009902	1.014877
4½	1.011126	1.016720
5	1.012348	1.018559
5½	1.013567	1.020395
6	1.014781	1.022257
6½	1.015993	1.024055
7	1.017204	1.025880

The construction of this table is from an algebraic theorem, given by the learned A. De Moivre, in his treatise of annuities on lives; which may be in words, thus:

For half-yearly payments, take a unit from the ratio, and from the square root of the ratio; half the quotient of the first remainder, divided by the latter, will be the tabular number.

For quarterly payments, use the 4th root, as above, and take one quarter of the quotient.

ANNUITIES AT COMPOUND INTEREST.

Case 1.

The annuity, time, and rate of interest, given, to find the amount.

Rule.

Multiply the number under the rate, and opposite the time, in Table III., by the annuity; and the product will be the amount for yearly payments.

Note.—When the payments are to be made half-yearly or quarterly, the amount for the given time, found as above, multiplied by the proper number in Table V., will be the true amount.

Case 2.

The annuity, time, and rate, given, to find the present worth.

Rule.

Multiply the number under the rate, and opposite the time, in Table IV., by the annuity; the product will be the present worth for yearly payments.

Note.—When the payments are to be made half-yearly or quarterly, the present worth so found must be multiplied by the proper number in Table V.

Questions.

What are annuities at compound interest?

When the annuity, time, and rate of interest, are given, by what rule do you find the amount?

What is to be noticed, when the payments are half-yearly or quarterly?

When the annuity, time, and rate, are given, to find the present worth, how do you proceed?

What is to be noticed, when the payments are half-yearly or quarterly?

ANNUITIES IN REVERSION.

Sums of money which are payable yearly for a limited period, but which do not commence till after the expiration of a given period, are called annuities in reversion.

The annuity, time of reversion, time of continuance, and rate, given, to find the present worth of the reversion

Rule.

Take two numbers under the given rate [illegible] Table IV., that opposite the sum of the two given times; and the number opposite the time when the annuity is to commence, or time of reversion, and multiply their difference by the annuity for the present worth.

Note.—When the payments are to be half-yearly or quarterly, use Table V., as before.

Questions.

What are annuities in reversion?

When the annuity, time of reversion, time of continuance, and rate, are given, to find the present worth, by what rule do you work?

What is to be noticed, when the payments are half-yearly or quarterly?

PERPETUITIES AT COMPOUND INTEREST.

Annuities which continue for ever, are called Perpetuities.

The annuity and rate given, to find the present worth.

Rule.

Divide the annuity by the ratio, less 1, for the present worth.

Note.—Table V. must be used as in temporary annuities, when the payments are half-yearly or quarterly.

Questions.

What name is given to annuities which continue for ever?

By what rule do you proceed, when the annuity and rate are given to find the present worth?

What is to be noted, when the payments are half-yearly or quarterly?

COMPOUND INTEREST BY DECIMALS.

Examples.

1. What is the interest and amount of £400, for 3 years, at 4 per cent?

$$
\begin{array}{r}
1.04\times1.04\times1.04=1.124864 \\
400 \\
\hline
449.945600 \text{ amount.} \\
400 \\
\hline
\text{Ans. } 49.9456 \text{ interest.}
\end{array}
$$

2. What is the amount and interest of £750, at 5 per cent. per annum, for 4 years and 6 months?
Ans. Amount, £934 2*s*. 10*d*.; interest, £184 2*s*. 10*d*.

Case 2.

1. What principal, put to interest, will amount to £695 13*s*. 9*d*., in 5 years, at 5 per cent.? *Ans.* £545 1*s*. 9*d*.+

2. What principal must be put to interest, to amount to £260 5*s.* 3*d.*, at 6 per cent. per annum, for 3 years?
Ans. £218 10*s.* 5*d.*

ANNUITIES AT COMPOUND INTEREST.

Case 1.

1. What is the amount of an annuity of 180 dollars, for 9 years, at 5 per cent.?

```
 11.026564
       180
----------
 882125120
 11026564
----------
$1984.781520  Ans.
```

2. What will an annuity of $200 amount to in 5 years, to be paid by half-yearly payments, at 6 per cent. per annum? *Ans.* $1144 08*cts.* 2*m.*+

Case 2.

1. What is the present worth of £50 per annum, for 6 years, at 4 per cent.?

```
   5.24214
        50
----------
£262.10700  Ans.
```

2. What is the present worth of 70 dollars a year, for 5 years, payable yearly, half-yearly, and quarterly, at 6 per cent. per annum?

Ans. { Yearly, $294 86*cts.* 5*m.*+
Half-yearly, $299 22*cts.* 3*m.*+
Quarterly, $301 42*cts.* 8*m.*+

ANNUITIES IN REVERSION.

1. The reversion of a freehold estate of £60 per annum, for 4 years, to commence 2 years hence: what is the present worth, allowing 4 per cent. for present payment?

5.24214
1.88609

3.35605
60

£201.36300 *Ans.*

2. What is the present worth of a reversion of a lease for $120 per annum, to continue 9 years, but not to commence till the end of 4 years, at 4 per cent., to the purchaser? *Ans.* $762 69*cts.* 1*m.*+

PERPETUITIES AT COMPOUND INTEREST.

1. What is the present worth of an annuity of £150 per annum, to continue for ever, allowing 5 per cent. to the purchaser? 1.05—1=.05)150.00

$3000 *Ans.*

2. What is an estate of 260 dollars per annum, to continue for ever, worth in present money, allowing 6 per cent. to the purchaser? *Ans.* $4333 33*cts.* 3*m.*+

* * *

COMBINATION.

Combination is used to show how many different ways a less number of things can be combined out of a greater; as, out of the figures 1, 2, 3, the three combinations, 12, 13, and 23, may be formed.

Rule.

1. Take a series, proceeding from and increasing by a unit, up to the number to be combined.

2. Take another series, of as many places, decreasing by unity from the number out of which the combinations are to be made.

3. Multiply the first continually for a divisor, and the latter for a dividend; the quotient will be the answer.

Questions.

What is Combination?

By what rule do you work questions in Combination?

Examples.

1. How many combinations of 3 persons in 6?

$$\frac{6\times5\times4}{1\times2\times3}=20 \quad \textit{Ans.}$$

2. How many combinations of 10 figures may be made out of 20? *Ans.* 184756.

Note.—The operation of a question may be contracted, by dividing the numbers of the increasing series into those of the decreasing, until the form[illegible]e entirely cancelled. The continued product of the undivided numbers of the latter, and the quotients, will be the number of combinations; thus:

$$\begin{array}{cccccccccc}
\cancel{20}. & 19. & \cancel{18}. & 17. & \cancel{16}. & \cancel{15}. & \cancel{14}. & 13. & \cancel{12}. & 11. \\
\cancel{2} & & 2 & & \cancel{2} & \cancel{3} & \cancel{2} & & 2 & \\
1. & \cancel{2}. & \cancel{3}. & \cancel{4}. & \cancel{5}. & \cancel{6}. & \cancel{7}. & \cancel{8}. & \cancel{9}. & \cancel{10}.
\end{array}$$

$$19\times2\times17\times13\times2\times11=184756.$$

◆

PERMUTATION.

Permutation is used to find how many different ways a given number of things may be varied in succession; as, 123, 132, 213, 231, 312, 321, are si[illegible]ifferent permutations of three figures.

Rule.

Multiply all the numbers continually in succession, from one to the given number inclusive; the product will be the number of variations.

Questions.

What is Permutation?

What is the rule for finding the number of variations in any given number?

Examples.

1. In how many different positions can 7 men place themselves round a table?

$$1\times2\times3\times4\times5\times6\times7=5040. \quad \textit{Ans.}$$

2. In what time will a person make all the changes that the 12 first letters of the alphabet admit of; allowing 15 seconds for each change? *Ans.* 227 *years* 248*da.* 6*h.*

DUODECIMALS.

DUODECIMALS are parts of a foot, the denominations of which increase continually by 12.

The denominations are,

12 Fourths'''' make 1 Third'''.
12 Thirds —— 1 Second''.
12 Seconds —— 1 Inch, *In.*
12 Inches —— [illegible] Foot, *Ft.*

Questions.

What are Duodecimals?
What are the denominations of Duodecimals?

ADDITION OF DUODECIMALS.

Rule.

Add as in Compound Addition, and carry 1 for every 12 to the next denomination.

Question.

How is addition of duodecimals performed?

Examples.

Ft.	*In.*	''	'''	''''
10	5	6	11	6
15	9	5	2	10
18	4	1	7	9
12	8	6	5	7

Ft.	*In.*	''	'''	''''
37	8	10	6	9
43	11	2	4	7
19	7	5	3	8
18	4	1	7	2

3. Three boards measure as follows: 16*Ft.* 8*in.*, 14*Ft.* 6*in.*, 17*Ft.* 9*in.* 2'': how many feet do they contain?
Ans. 48*Ft.* 11*in.* 2''.

SUBTRACTION OF DUODECIMALS.

Perform the operation as in compound subtraction.

Question.

How are operations in subtraction of duodecimals performed?

Examples.

Ft.	*in.*	″	‴	⁗
38	8	4	7	5
15	11	6	9	3

Ft.	*in.*	″	‴	⁗
720	3	8	1	6
13	9	4	7	10

3. If, from a room measuring 475*Ft.* 7*in.* 2″, I partition off 81*Ft.* 2*in.* 5″ 10‴ 6⁗, how long will the room still be?
Ans. 394*Ft.* 4*in.* 8″ 1‴ 6⁗.

MULTIPLICATION OF DUODECIMALS.

Case 1.

When the feet of the multiplier are not more than 12.

Rule.

1. Set the multiplier in such a manner, that the feet thereof may stand under the lowest denomination of the multiplicand; and, in multiplying, carry 1 for every 12 from one denomination to another; and place the result of the lowest denomination in the multiplicand, under its multiplier.

Case 2.

When the feet of the multiplier exceed 12.

Rule.

Multiply by the component parts, as in compound multiplication; and take parts for the inches, as in practice.

Questions.

By what rule do you work, in multiplication of duodecimals, when the feet in the multiplier do not exceed 12?

How do you proceed, when the feet of the multiplier exceed 12?

Examples.

1. Multiply 5*Ft.* 6*in.* by 2*Ft.* 4*in.*

$$\begin{array}{rrr} \text{Ft.} & \text{in.} & \\ 5 & 6 & \\ & 2 & 4 \\ \hline 1 & 10 & 0 \\ 11 & 0 & \\ \hline \text{Ft. } 12 & 10 & 0 \quad \text{Ans.} \end{array}$$

2. Multiply 54*Ft.* 10*in.* by 5*Ft.* 7*in.*

Ans. 306*Ft.* 1*in.* 10″

3. What are the contents of a door, measuring in lengt 6*Ft.* 9*in.* 3″, and in width 3*Ft.* 5*in.*

Ans. 23*Ft.* 1*in.* 7″ 3‴.

Case 2.

1. Multiply 208*Ft.* 8*in.* 4″, by 24*Ft.* 3*in.* 9″.

$$\begin{array}{r|c|rrrr} \text{in.} & & \text{Ft.} & \text{in.} & '' & \\ 3 & \frac{1}{4} & 208 & 8 & 4 & \\ & & & & 6\times 4 & \\ \cline{3-5} & & 1252 & 2 & 0 & \\ & & & & 4 & \\ \cline{3-5} & & 5008 & 8 & 0 & \\ 9'' & \frac{1}{4} & 52 & 2 & 1 & \\ & & 13 & 0 & 6 & 3 \\ \cline{3-6} & & 5073 & 10 & 7 & 3 \quad \text{Ans.} \end{array}$$

2. A partition is 81*Ft.* 10*in.* 4″ long, and 14*Ft.* 7*in.* high: how many yards does it contain?

Ans. 132*Yd.* 8*ft.* 7*in.* 9″ 7‴ 8′″.

3. How many square feet of roof will 1000 shingl cover, when the shingles are 2*Ft.* 5*in.* 7″ 2‴ in leng and 5*in.* 3″ 6‴ 5⁗ in width?

Ans. 1088*Ft.* 2*in.* 8″ 3‴ 3⁗.+

PROMISCUOUS EXAMPLES.

1. A. is 25 years old, B. 15 years older than A., and C. is 12 years older than B.: the ages of B. and C. are required. *Ans.* B. 40 *years*, C. 52 *years.*

2. A., B., and C. have $220 50*cts.*, and are desirous to share it in the proportion of A. $\frac{1}{5}$, B. $\frac{1}{6}$, and C. the rest; but B. is willing his share shall be divided equally between A. and C.: it is required, what will A., B., and C. receive individually, according to the first proportion; and what will be the shares of A. and C. each, after B.'s relinquishing his share?

Ans. A. will receive $44 10*cts.*, B. $36 75*cts.*, C. $139 65*cts.*; A. will receive, after B. relinquishes, $62 47*cts.* 5*m.*; C. $158 02*cts.* 5*m.*

3. A person sells a piece of cloth at $56 25*cts.*, and thereby loses $7\frac{1}{2}$ per cent.: what was the first cost?

Ans. $60 81*cts.* 5*m.*+

4. If A. travel by mail at the rate of 8 miles an hour, and when he is 50 miles on his way, B. start from the same place that A. did, and travel on horseback the same road at 10 miles an hour, how long and how far will B. travel to come up with A.? *Ans.* 25 *hours*, and 250 *miles.*

5. Bought a quantity of cloth for $750, $\frac{5}{26}$ of which I found to be inferior, which I had to sell at $1 25*cts.* per yard, and by this I lost $100: what must I sell the rest at per yard, that I shall lose nothing by the whole?

Ans. $3 $15\frac{10}{21}$*cts.*

6. If 1000 bricks lie 6 inches from each other, in a straight line, and a person be employed to gather them up, one by one, and place them on a pile, which is one foot from the first brick, how far will he have walked when he shall have placed the last brick on the pile?

Ans. 94*M.* 7*fur.* 186*yd.* 2*ft.*

7. Three bricklayers, A., B., and C., can raise the walls of a house in 20 days; B., C., and D. in 24; C., D., and A. in 30; and A., B., and D. can do it in 36 days: in

what time can A., B., C., and D. do it together, and i what time can each do it by himself? *Ans.* 19$\frac{7}{11}$ together

A. 108 *days.*, B. 56$\frac{16}{19}$*da.*, C. 43$\frac{1}{5}$*da.* D. 1080*da.*

8. If I would exchange £1055 15*s.* for dollars, at 9 a-piece, ducats at 11*s.* 4*d.* a-piece, and crowns at 12*s.* 2d a-piece; and would have 6 dollars for 4 ducats, and 3 dollars for 4 crowns; how many of each sort must I have?

Ans. Dollars, 644$\frac{5}{11}$.
Ducats, 429[illegible].
Crowns, 858$\frac{6}{11}$.

9. A. and B. dissolve partnership, and equally divid their gain: A.'s share, which was $332 50*cts.*, lay for 2 months; B.'s for 9 months only: the adventure of B. required. *Ans.* $775 83$\frac{1}{3}$*cts.*

10. If 4 years should be added to a lease of 12 yea yet to come, the advance rent being $720 25*cts.* pe annum, what should be paid down for the additional years, discount being allowed at 5 per cent. per annu compound interest? *Ans.* $1422 14*cts.* 8*m.*

11. A gate-keeper is to receive 6*cts.* for every wage 4*cts.* for every gig, 2*cts.* for every horseman, and 1*ct.* f every footman, that passes the gate: at the year's end, found that 3150 gigs had passed; and that 7 gigs pa when 5 wagons did; and 4 horsemen passed when 6 fo men did; and 5 footmen passed when 3 gigs did: wh number of wagons, horsemen, and footmen, passed; a how much did the gate-keeper receive?

Ans.	Gigs,	3150.
	Wagons,	2250.
	Footmen,	5250.
	Horsemen,	3500.
	Amount of toll,	$383 50*cts.*

12. If a water-hogshead holds 110*gal.*, and the pi which fills the hogshead discharges 15*gal.* in 3 minute and the tap will discharge 20*gal.* in 5 minutes, and the were both left running one hour, how many gallons woul the hogshead then contain; and if the tap was th stopped, in what time would the hogshead be filled?

Ans. 60*gal.*, and filled in 10*min.*

13. A. has 28*cwt.* of cotton, which cost him $264: how must he rate it per pound to D., so that by taking his note, payable at 9 months, he may clear $30, allowing interest at 6 per cent. per annum? *Ans.* 9*cts.* 7*m.*

14. A., B., and C., in company, had put in $5762: A.'s money was in 5 months, B.'s 7, and C.'s 9 months: they gained $780, which was so divided, that $\frac{1}{4}$ of A.'s was $\frac{1}{5}$ of B.'s, and $\frac{1}{5}$ of B.'s was $\frac{1}{3}$ of C.'s: but B., having received $2087, absconded: what did each gain, and put in; and what did A. and C. gain or lose by B.'s misconduct?

Ans.
A.'s share of profit, $260
B.'s do. do. $325
C.'s do. do. $195
A. and C. would gain $697 39*cts.*

15. A. had 20 hogsheads of sugar, which he sold to B. at 5½ per cent. loss; who sold them to C. for $20 75*cts.* clear; C. parted with them to D. for $1000, and thereby cleared 5¾ per cent.: what did the sugar cost A. per hogshead? *Ans.* $48 93*cts.* 5*m.*

16. Suppose A. lets B. have a hogshead of sugar, of 10 cwt., worth $7, for $11 per cwt., one-third of which, he is to pay in cash; B. has paper, which cost $4 50*cts.* per ream, which he gave A., for the rest of his sugar, at $5 25*cts.*: which gained most by the bargain?
Ans. A. gained most, by $27 77*cts.* 8*m.*

17. A father left his estate of $1300 to his only son; but he being only 14 years of age, his guardian was to pay $100 per annum for board, education, &c., and the surplus was to be put out to interest, for his benefit, at 6 per cent. compound interest: now, allowing no loss, what sum had his guardian to pay him when he was of age?
Ans. $1115 33*cts.* 5*m.*

18. There are two columns, in the ruins of Persepolis, left standing upright; one is 64 feet above the plain, the other 50. Between these, in a right line, stands an ancient statue, the head whereof is 97 feet from the summit of the higher, and 86 feet from the top of the lower column, and the distance between the lower column

and the centre of the statue's base, is 76 feet; the di tance between the top of the columns is required.

Ans. 157+*feet.*

Note.—Sound, if not interrupted, will move at the rate of abou 1150 feet in a second of time.

19. If I see the flash of a cannon, fired from a fort o the other side of a river, and hear the report 47 se onds afterwards, what distance was the fort from wher stood? *Ans.* 54050 *feet.*

20. If a vessel, in time of distress, shall discharge gun, in what time will the report be heard by anoth vessel, at a distance of 15 miles 7 furlongs from them?

Ans. 1*min.* $12\frac{103}{115}$*sec.*

21. Hiero, king of Sicily, ordered his jeweller to ma a crown, containing 63 ounces of gold. The workm thought, that substituting a part silver was only a prop perquisite; which taking air, Archimedes was appoint to examine it, who, on putting it into a vessel of wat found it raised the fluid 8.2245 cubic inches; and hav discovered that the inch of gold weighed 10.36 ounc and that of silver but 5.85 ounces, he found what pa the king's gold had been changed. Repeat the proc and inform us what part of it was gold, and what silve

Ans. { 28.8035+*oz.* silver.
34.1964+*oz.* gold.

22. If a mess of 6 men receive for 3 rations 7*lb.* beef and 5*lb.* of bread a day, the beef cost $5\frac{3}{4}$*cts.* pound, and the bread 6*cts.* per pound: now if the b for a certain number of men cost $34 50*cts.*, what will cost for bread for them? *Ans.* $25 71*cts.* 4*m.*+

23. What number is that, to which, if $\frac{4}{9}$ of $\frac{5}{7}$ of be added, the total will be 1? *Ans.* $\frac{31979}{35168}$

24. What is the difference between the interest $1000 at 6 per cent. for 8 years, and the discount of t same sum at the same rate, and for the same time?

Ans. The interest exceeds the discount
$155 67*cts.* 5*m.*

25. What is the difference between the sum of the square root of 32 and 24, and the cube root of 67?

Ans. 6.496.

26. What will purchase $2450 stock, at 105$\frac{3}{5}$ per cent.?

Ans. $2587 20*cts.*

27. A. has B.'s note for $500 75*cts.*, with 9 months' interest, at 6 per cent., due on it, for which B. gave him 5064 feet of boards, at 2$\frac{1}{2}$*cts.* per foot, with 140 pounds of tallow, at 13*cts.* per pound, and is to pay the rest in flax-seed, at 92$\frac{1}{2}$*cts.* per bushel: how many bushels of flax-seed must A. receive, to balance the note?

Ans. 409$\frac{159}{925}$ *bushels.*

28. A father, desirous to encourage his son at school, promises to give him 6*cts.* the first quarter, 9*cts.* the second, increasing arithmetically: the boy has now been at school 9 years, and wishes to know what is due him.

Ans. $21 06*cts.*

29. A sum of $2363 38$\frac{3}{4}$*cts.* is left to be paid in 5 years' time; but the person holding the money is willing to pay it at the expiration of 2 years and 3 months, upon being allowed discount at compound interest at 6 per cent.; which being agreed to, what must he pay?

Ans. $2012 82*cts.* 9*m.*

30. A bond was given on the 14th of January, 1802, at 5 per cent. per annum, for the sum of $1854.69*cts.*; on the 5th of July, 1807, $285 were paid off, and a fresh bond entered into for the remainder, at 4$\frac{3}{4}$ per cent. per annum; at the time the interest of this last was $52 65*cts.*, there was paid off $102 43*cts.*, the old bond being then taken up, a new one was then given for the residue, which being paid off on the 26th of October, 1813, the bond-owner gave a receipt in full for $2497 03*cts.* 2*m.*; at what rate then did he take interest per cent. per annum, upon the last renewal of the bond?

Ans. 4 per cent.

31. A person having driven a stock of cattle to market, received for them all $456: he received $50 for each horse, $20 for each cow, and $4 for each sheep; the number of cows was double the number of horses, and

there were three times as many sheep as cows: what did he receive for the horses, what for the cows, and what for the sheep; and how many of each sort were there?

Ans. { 24 *sheep*, $ 96.
8 *cows*, $160.
4 *horses*, $200. }

32. How much gold, of 17 and 24 carats fine, must be melted with 10 oz. of 16 carats fine and 20 oz. of 19 carats fine, to make a mixture of 50 oz. 19 carats fine?

Ans. 10 of 17 *carats*, 10 of 24 *carats*.

33. A case of goods, amounting to £230 5*s.* Sterling, is sold at Philadelphia at 20 per cent. advance: what is the amount in Federal money? *Ans.* $1227 87*cts.* 7*m.*

34. If a tower be built in the following manner, $\frac{87}{170}$ of its height of stone, 27 feet of brick, and $\frac{1}{4}$ of its height of wood, what was the height of the tower?

Ans. 113 *feet* 4 *inches.*

35. When I, by disposing of a yard of cloth, at $7, gain 56$\frac{1}{4}$*cts.*, what would I gain by selling 3 pieces, which cost me $400? *Ans.* $32 14$\frac{2}{7}$*cts.*

36. If a man buy 25 yards of lace, at 30*cts.* for the first yard, and for the last yard 96*cts.* the price of each yard increasing in arithmetical progression, what did the whole amount to? *Ans.* $15 75*cts.*

37. If of two numbers 47 is the less, to which the other is in proportion as 9 to 4, what is their sum, and the product of their sum and difference?

Ans. { Sum, 152.75.
Difference, 58.75.
Product of sum and dif. 8974.0625. }

THE END.

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